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Factors Influencing Mammography Utilization Among Disabled and Nondisabled Women

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Factors Influencing Mammography Utilization Among Disabled and Nondisabled Women

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy at Virginia Commonwealth University

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Well, I've been down a time or two,

But it never lasted long.

I can always make it through

On a wing and a prayer and a song.

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What I have learned the most is that the completion of a doctoral degree is not a solo effort. Rather, it is the culmination of the efforts of many people, including faculty, family, and friends. I would especially like to recognize the following people who provided the "wings" and "prayers" that helped make my doctoral pursuits so enjoyable:

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Abstract

FACTORS INFLUENCING MAMMOGRAPHY UTILIZATION AMONG DISABLED AND NONDISABLED WOMEN

Jeffrey S. Legg, Ph.D.

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University, 2002.

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Breast cancer is the second leading cause of cancer mortality in women in the United States. Because the majority of risk factors for breast cancer are not modifiable, early detection methods such as mammography are essential. However, concern exists for the equitable provision and use of mammography services in the U.S. Mammography is often underutilized by various subpopulations resulting, potentially, in these groups not experiencing the benefits of early detection. A subpopulation that has received little attention in the study of mammography utilization encompasses persons classified as disabled.

The 1998 National Health Interview Survey provided the data for this analysis. A health services utilization model served as the conceptual framework and was adopted to analyze the multiple factors that influence mammography use, including factors such as

the environment, population characteristics, health behaviors, and health outcomes. In this study, disability is defined as those women with any self reported limitations in activities of daily living, instrumental activities of daily living, cognition, or work.

Results indicate that the mammography utilization rate for disabled women (n = 1,320) was 42.99%, and significantly lower than the rate of 57.37% for nondisabled women (n = 4,733) ($z = 646.83$; $p = .00$). This finding was consistent across most study variables. Binary logistic regression results indicate that women with cognitive limitations were nearly half as likely than nondisabled women to utilize mammography (AOR = 0.66; 95% CI: 0.45, 0.97) after controlling for other factors. In the logistic regression analysis, particular, population characteristics (i.e., age, race/ethnicity, education, and health insurance) and health behaviors (i.e., smoking status, clinical breast examination, and usual source of care) were shown to significantly influence mammography utilization.

Results indicate that inequity in mammography utilization exists because disabled women's utilization rates are lower than the rates for nondisabled women. Because disabled women, especially those cognitively impaired, used mammography at lower rates than nondisabled women, disabled women may not realize the benefits of early detection of breast cancer. Furthermore, they may potentially experience both higher rates of undetected breast cancer and breast cancer mortality.

CHAPTER 1: INTRODUCTION

Overview

Breast cancer, the second leading cause of cancer mortality in women in the United States (U.S.) (Howe et al., 2001; National Cancer Institute [NCI], 1998), was estimated to be the cause of death for approximately 40,600 women in 2001 (American Cancer Society [ACS], 2001). One woman in eight will develop breast cancer in her lifetime (Feuer et al., 1993) with 193,700 new diagnoses of invasive breast cancer predicted in 2001 (ACS, 2001). A woman's risk of developing breast cancer is strongly associated with age. Older women are significantly more likely to develop breast cancers than younger women (Howe et al., 2001; Shapiro, Venet, Strax, Venet, & Roeser, 1982). In addition to age, other risk factors include a family history of breast cancer, early age at menarche, late age at the birth of the first child, and genetic predisposition (NCI, 1998). Because primary preventive options for mortality reduction are limited due to the nonmodifiable nature of many established risk factors (i.e., age, race, genetic predisposition), early detection and diagnosis play a vital role in reducing breast cancer mortality (Madigan, Ziegler, Benichou, Byrne, & Hoover, 1995).

Various practices are recommended for the early detection of breast cancer, including clinical breast examination, self breast examination, and mammography. Mammography is the imaging of the breast tissue using radiation and an image recording medium (i.e., radiographic film or digital detector). Mammography is the most effective

diagnostic tool in the detection of breast cancer, with varying ability to detect abnormalities. Sensitivities between 76% to 94% for detecting breast cancers via mammography are reported by the ACS (1997). Early detection via mammography has demonstrated reductions in mortality from the disease. These conclusions are based on results from case-control and cohort studies (Collette, Day, Rombach, & deWaard, 1984; Verbeek et al., 1984) and major randomized controlled trials, both within and outside the U.S. (Frisell et al., 1991; Miller, Baines, To, & Wall, 1992b; Miller, Howe, & Wall, 1981; Shapiro, Venet, Strax, Venet, & Roeser, 1982; Tabar et al., 1992; Tabar, Faberberg, Day, & Holmberg, 1987). Kerlikowske and colleagues (1995) posit that the judicious utilization of mammography (i.e., utilization at age appropriate levels) could prevent approximately one-fourth of breast cancer deaths.

Currently, a strong consensus exists among national organizations and physician specialty groups for mammography recommendations for women ages 50 years and older. The following organizations recommend annual screening mammography for women ≥ 50 years:

- American Cancer Society (Smith, Mettlin, Johnston, Davis, & Eyre, 2000)
- American Medical Association (AMA) (AMA, 1999)
- National Institute of Health (NIH) (NIH, 1997)
- American College of Radiology (ACR) (ACR, 1999)
- American Academy of Family Physicians (AAFP) (AAFP, 2000)
- American College of Obstetricians and Gynecologists (ACOG) (ACOG, 2000).

However, less agreement is found regarding mammography screening recommendations for women ages 40 to 49 years. Although the ACS, AMA, and ACR recommend annual screening mammography for women in this age cohort, the ACOG, and NIH recommended mammography be done every one to two years.

As evidenced by the attention of national organizations and professional medical societies, mammography and breast cancer prevention are national health concerns. The U.S. Department of Health and Human Services (U.S. DHHS) continues to identify mammography as an important indicator for preventive service use. The Healthy People Initiative is the prevention agenda for the U.S., in which the national health improvement goals for 10-year periods are established. The Healthy People 2000 campaign established a goal that 60% of women age ≥ 50 years undergo mammography within the previous two years (National Center for Health Statistics [NCHS], 1999; NCHS, 1993; U.S. DHHS, 1990). In the Healthy People 2010 campaign, the goal for biennial mammography screening for women has been increased to 70% of women ages ≥50 years (U.S. DHHS, 2000).

Estimates vary for the use of mammography by the general U.S. population. A main reason for the difficulty in comparing population-based studies is the use of different outcome measures for assessing mammography use. Mammography use is measured traditionally according to a woman's annual or biennial attendance of mammography examinations. Annual use refers to the individual having a mammogram within the previous year/12-month period. Biennial use is having a mammogram within the previous two-years/24-month period. To provide a better understanding of

mammography use by U.S. women, examples of recent population-based studies measuring both annual and biennial use are reported.

Annual Mammography Rates

Using data from the 1992 National Health Interview Survey (NHIS) Cancer Control Supplements, Martin and colleagues (1996) found that only 29% of women age≥40 years reported having a mammogram within the past year. Horton, Cruess, and Romans (1996) report an annual mammography rate of 49.6% for women ages 50-64 years. A rate of 40.4% was reported among women ages ≥ 65 years in 1995. Horton and colleagues' results were based on a weighted, nationally representative telephone survey.

Biennial Mammography Rates

Based on Centers for Medicare & Medicaid Services (CMS)--formerly Health Care Financing Administration (HCFA)-- enrollment and claims files, the estimated biennial rate of mammography use for Medicare recipients (i.e., ≥ 65 years), by state, ranged from 32.2 to 48.4% during the 1994-1995 period. Interestingly, no state reached the Year 2000 goal of 60% biennial utilization (U.S. DHHS, 1997). Blustein and Weiss (1998) report similar results; approximately 27% of Medicare beneficiaries ≥ 75 years had mammograms during the previous two-year period (i.e., 1991-1992).

Population-based studies also reveal varying utilization rates by subpopulations. For example, a consistent finding is lower rates of mammography use by minorities (i.e., African-Americans, Hispanics, Native Americans) as compared to Caucasians (Burack, Gurney, & McDaniel, 1998; Burns et al., 1996; Calle, Flanders, Thun, & Martin, 1993; Frazier, Jiles, & Mayberry, 1996; Maxwell, Kozak, Desjardins-Denault, Parboosingh,

1997; NCI Breast Cancer Screening Consortium, 1990; Zapka, Stoddard, Maul, & Costanza, 1991). Data based on mammography services paid by Medicare are illustrative of the racial disparities in mammography use. In 1995, 27.1% of Caucasian women had a mammogram as compared to 20.6% of African-American Medicare beneficiaries (U.S. DHHS, 1997). Despite differences in the outcome measures used to measure mammography utilization as well as disparities in use by various minority groups, mammography screening rates for the total U.S. female population are low and do not meet the Healthy People 2000 goal of screening 60% of women ≥ 50 years.

Problem

Concern exists for the equitable provision and use of health care, including mammography. Access to health care is defined as equitable or inequitable based on the factors or characteristics that predict an individual's realized (or actual) access (Andersen & Davidson, 1999). Some of the factors that influence health care use include demographic characteristics (i.e., age, race, and ethnicity) and enabling resources (i.e., income, insurance). The study of equity in healthcare seeks to determine if the benefits and burdens of medical care are distributed fairly throughout the population (Aday, Begley, Lairson, & Slater, 1998). Inequitable access exists when health services are distributed without consideration of the need for health care services (Aday, Begley, Lairson, & Slater, 1998; Andersen & Davidson, 1999). For example, inequitable access to mammography might exist if certain subpopulations lack the financial resources (i.e., enabling factors) to obtain examinations. A second example occurs when a subpopulation's use of mammography is lower than other groups when all other factors

are held constant. Examples of these subpopulations might include racial/ethnic minority, low socioeconomic status, or disabled women. Consequently, underutilization of mammography by these subpopulations may occur, resulting in these underserved women not experiencing the benefits of early detection. Lower utilization for particular subpopulations leads to higher mortality rates from breast cancer.

Inequities in mammography utilization according to demographic and enabling factors of the individual have been demonstrated. As discussed previously, women who are members of a minority group demonstrate lower rates of mammography use than Caucasian women. Women who have lower income (Bush & Langer, 1998; Maxwell, Kozak, Desjardins-Denault, Parboosingh, 1997; Montaño, Thompson, Taylor, & Mahloch, 1997; Phillips, Kerlikowske, Baker, Chang, & Brown, 1998; Urban, Andersen, & Peacock, 1994), and older (i.e., ≥75 years) (Balducci & Phillips, 1998; Breen, Feuer, Depuy, & Zapka, 1997; Persky & Burack, 1997) demonstrate lower rates of mammography utilization as well.

Other factors associated with decreased utilization of mammography include residence in a rural locality (Ives, Lave, Traven, Schulz, & Kuller, 1996; Stoner et al., 1998), low educational attainment, (Calle, Flanders, Thun, & Martin, 1993; Frazier, Jiles, & Mayberry, 1996; Horton, Cruess, & Romans, 1996; NCI Breast Cancer Screening Consortium, 1990; Pearlman, Rakowski, & Ehrich, 1996) and lack of health insurance (Faulkner & Schauffller, 1997; Gordon, Rundall, & Parker, 1998). Because of an interrelation between income and insurance coverage, employment and cost of coverage have historically been considered to influence whether or not one can obtain

mammography screening (Faulkner & Schauffler, 1997; Hagdrup, Simoes, & Brownson, 1997). Burack, Gurney, and McDaniel (1998), using the 1992 NHIS and Cancer Control Supplement, indicate that mammography use is lower in women with "poor" self-reported health status. Use of other preventive services (e.g., Papanicolaou smears, clinical breast examination) and engaging in healthy behaviors/practices are associated positively with one's use of mammography screening (Burack, Gurney, & McDaniel, 1998; Fontaine, Faith, Allison, & Cheskin, 1998; Hofer & Katz, 1996).

However, a subpopulation that has received little attention in the study of mammography utilization encompasses those persons classified as disabled. The disabled population is a large group in the U.S., estimated at 20.6% of the total U.S. population in 1994-1995 (U.S. Department of Commerce, 1997). Approximately 26 million women live with disabilities (McNeil, 1993). The Americans with Disabilities Act of 1990 (ADA) defines disability as a "physical or mental impairment that substantially limits one or more of the major life activities" (Hablutzel & McMahon, 1998). The definition used by the U.S. Census Bureau (U.S. Department of Commerce, 1997) is more specific. Disability among adults is defined as those persons ≥15 years who meet any of the following examples of criteria:

- used a wheelchair or were a long-term user of a cane, crutches, or a walker,
- had difficulty performing one or more functional activities (seeing, hearing, speaking, lifting/carrying, using stairs, or walking),
- had difficulty with one or more activities of daily living (i.e., getting around inside the home, getting in or out of bed or a chair, bathing, dressing, eating, and toileting),

- had difficulty with one or more instrumental activities of daily living (i.e., going outside the home, keeping track of money and bills, preparing meals, doing light house-work, taking prescription medicines in the right amount at the right time, and using the telephone),
- had one or more specified conditions (e.g., a learning disability, mental retardation or another developmental disability, Alzheimer's disease, or some other type of mental or emotional condition). Although this broad criterion includes a variety of specified conditions, they are associated with limitations in individuals' functional or work-related activities.

The disabled population, although large, has been declining among the elderly over time based on various national-level surveys such as the National Long-Term Care Survey, National Health Interview Survey, National Nursing Home Survey, and the Medicare Current Beneficiary Survey (Cutler, 2001). Despite the overall declines in the proportion of disabled and impaired persons in the U.S., the presence of disability/limitations and chronic disease (which can affect functioning) increases with age (LaPlante, Rice, & Kraus, 1991; McNeil, 1997). Due to the association between aging and disability, the presence of a disability is a potentially important factor influencing the use of mammography by both the disabled and nondisabled women. Examining the use of health care services is important to determine if health care is provided in an equitable manner so that all women, regardless of disability status, can benefit from mortality reductions in breast cancer.

Unfortunately, information on the use of preventive health care (e.g., mammography, Pap tests) by disabled women is scarce (Nosek & Howland, 1997; Thierry, 2000). Nonetheless, disabled women, among the most disadvantaged groups in the nation (Welner, 1998), demonstrate lower utilization of preventive services, including mammography, when compared to nondisabled women (Burack, Gurney, & McDaniel, 1998; Chan et al., 1999; Nosek & Howland, 1997 ; "Use of Cervical," 1998).

The lack of studies that have reviewed mammography utilization, especially for disabled women, is an indication of the difficulty in understanding the relationships or associations between many sociodemographic factors. Strong associations (i.e., confounding) among race, socioeconomic variables, functional and health status measures are identified in the literature for the general population (Gornick, 2000; LaVeist, Bowie, & Cooley-Quille, 2000; NCHS, 1998; Power, Hertzman, Matthews & Manor, 1997; Rosenbach, Adamache, & Khandker, 1995). In general, minorities have fewer enabling resources (i.e., income, health insurance) and report more functional and health limitations as compared to Caucasians. In 1996, for example, larger proportions of African American and Hispanic women (i.e., 42% and 44%, respectively) reported lower health status as compared to Caucasians (25%) in the Medicare Current Beneficiary Survey (Gornick, 2000). Because of these confounding relationships, differentiation among influential factors such as environmental, population characteristics, health behaviors, and health outcomes is important in evaluating the influence of mammography utilization by disabled women and for minorities.

A further limitation of previous studies is the age ranges of study populations. Most studies concentrate on disabled Medicare beneficiaries ≥ 65 years. Disabled women ages 50 to 64 years have been excluded despite their inclusion in the recommended age range for mammography screening.

Purpose

The goal of this study is to explore and assess the impact of factors such as environment, characteristics of the population, health behaviors, and health outcomes on the utilization of mammography by disabled and nondisabled American women ≥ 50 years. This study takes a broad view of disability by assessing both physical and mental factors that potentially serve as barriers to mammography use.

Disability, in this study, is the presence of self-reported functional limitations in daily activity as well as the presence of cognitive limitations (i.e., difficulties with memory and confusion). In addition, work limitations are included to expand the range of disabling factors and characteristics that may influence mammography utilization. A health services utilization model, Andersen's behavioral model of health services utilization, (Aday, Begley, Lairson, & Slater, 1998; Andersen, 1968; Andersen & Newman, 1973;Anderson & Davidson, 1999) serves as the conceptual framework that is adapted to analyze the multiple factors that influence health care utilization.

Research Question

This study seeks to answer the question: How do various environmental, population characteristics, health behaviors, and outcomes of health care influence the likelihood of having undergone mammography in the previous year for disabled and

nondisabled women ≥ 50 years? Research results will indicate whether equitable access to mammography exists for the disabled female population. Equitable access to mammography for disabled women is important so they, too, may benefit from the potential mortality reductions due to early detection of breast cancer.

Data and Analysis

The 1998 National Health Interview Survey (NHIS) provides the fundamental data for this analysis. The NHIS, conducted by NCHS consists of an annual face to face interview between trained data collectors and selected households. This cross-sectional survey uses a multistage probability sampling design to produce a nationally representative sample of the U.S. noninstitutionalized civilian population (NCHS, 1998). The survey includes information on patient demographics, medical conditions, insurance, and health behaviors. Unique patient identifiers are eliminated before public release of the data.

The 1998 NHIS represents the most currently available data at the time of this study. A total of 32,440 persons were sampled in the 1998 administration of the Sample Adult Prevention survey. The study's sample population is restricted to women ages ≥ 50 years who responded to the NHIS question regarding their use of mammography. The dependent variable, mammography use is defined as women who reported mammography use within the previous year. This operational definition is based on the consensus of various national organizations regarding recommended mammography guidelines for women ≥ 50 years.

Data are examined at the patient level using the Statistical Program for the Social Sciences (SPSS). The SUDAAN statistical package is used to estimate appropriate standard errors, accounting for both sample weights for respondents and the complex survey design. Standard statistical tests using population-level estimates are employed for uni- and bivariate analyses.

Because the dependent variable--self-reported mammography use--is a dichotomous variable, binary logistic regression is used to determine the influence of independent variables as well as control for potential confounders among disabled and nondisabled women. The health services utilization model (Aday, Begley, Lairson, & Slater, 1998; Andersen, 1968; Andersen & Newman, 1973; Anderson & Davidson, 1999) is used to conceptualize the environmental, personal, and other variables that influence the use of mammography services. In addition, other independent variables, based on a review of scholarly literature for the analysis, are included in the model to provide statistical control.

Significance

Considering the aging of the U.S. population, it is predicted that the disabled population will continue to grow (U.S. Department of Commerce, 1997). Additional research on the use of and access to health services by this subpopulation is needed. Because multiple factors influence the utilization of health care services by an individual, determination of influential factors (or the combination thereof) affecting mammography use by the disabled population is important for developing equitable health policy that addresses their needs.

The results of this study provide a broader perspective of mammography use by the disabled population by incorporating variables based on the health services utilization model. The inclusion of cognitive status, work and functional limitations, as well as other health behavior variables allows for more accurate determination of the factors, influences, and behaviors that impact mammography use by the disabled population. This study, in examining the influence of cognitive limitations (i.e., self-reported difficulty remembering and confusion) on mammography utilization expands the examination of disability by including nonphysical factors. In doing so this study builds upon--yet refines--previous investigations of the impact of disabilities on the use of mammography services by U.S. women ≥ 50 years.

From a health policy perspective, this study reveals disparities in the equitable access to mammography examinations among the disabled population. Disparities based on population characteristics (e.g., age, race/ethnicity, presence and/or type of health insurance, cognition) and health behaviors (e.g., CBE, usual source of care, smoking status) are found. Because many of these factors are modifiable (e.g., presence/type of health insurance, health behaviors) are found to influence mammography utilization by disabled women, health policies and interventions should be established to improve utilization for this subpopulation. The resulting health policies must then consider the social, economic, and personal factors of the disabled population and the population at large (Pearlman, Rakowski, & Ehrich, 1996). Examples of programs include incorporaton of interventions that identify and target cognitively limited women as well

as older women and minorities. In addition, voucher programs for mammography may improve mammography utilization among target populations.

Organization of Dissertation

Chapter 2, entitled the Literature Review, discusses the risk factors and preventive measures available for the early detection of breast cancer. Emphasized in this chapter is the utilization of mammography by U.S. women, including predictors and barriers to use. The incidence and types of disabilities, with particular focus on the relationship between disability and health status as it relates to the use of preventive care, are also discussed. Chapter 3, entitled Methods, describes the operational definitions, data sources, and analytic strategy of this analysis. Chapter 4, Results, describes the findings. Chapter 5, Discussion, addresses the results, limitations of the study, and the implications for health policy and future health services research.

CHAPTER 2: LITERATURE REVIEW

The purpose of this review is to summarize the vast literature concerning breast cancer and mammography to lay the theoretical foundation used in this study of the factors affecting the utilization of mammography by disabled women. Topics covered in this chapter include an overview of breast cancer and the primary method of detection--mammography; mammography utilization in the U.S.; factors associated with mammography use; an overview of disability and the disabled in the U.S.; and the conceptual framework/model upon which this study is based.

The chapter begins with a brief introduction to the incidence and mortality from breast cancer. Also discussed are the associated risk factors and the benefits of early detection. The second section discusses the disabled--a large subpopulation at-risk for underutilization of preventive health care services--as well as the study's conceptual framework and hypotheses. Last, mammography utilization rates and factors/characteristics associated with screening are discussed.

Breast Cancer in the United States

Overview and Prevalence

Breast cancer is the abnormal change and uncontrollable growth of the cells of the breast. There are several types of breast cancer, differing in their aggressiveness and the likelihood of spread to other parts of the body (Harvard Health Publications, 2000). The

two most common types of breast cancer are ductal carcinoma *in situ* (DCIS) and invasive ductal carcinoma (IDC). DCIS is a breast cancer confined to the ducts of the milk-producing glands that has not spread beyond those confines. It represents the earliest stage of breast cancer and nearly 100% of women with DCIS breast cancers can be cured. However, the most common form of breast cancer is IDC, representing approximately 75% of all breast cancers (Dow, 1997). In this form, the cancer spreads beyond the milk-producing ducts and invades the fatty tissues of the breast. Once the cancer has spread beyond the ducts, it is possible to metastasize to other parts of the body via the bloodstream or lymphatic vessels (Harvard Health Publications, 2000). Besides IDC, other invasive breast cancers are less common; they include medullary, tubular, colloid, and papillary carcinomas.

Breast cancer affects both males and females; however, it is more common in women. The etiology of breast cancer is unknown, although current theory on breast cancer focuses on a multifactorial etiology resulting from genetic, hormonal, and environmental factors (Dow, 1997; Harvard Health Publications, 2000). Breast cancer is the second leading cause of cancer mortality in U.S. women (Dow, 1997; Howe et al., 2001; NCI, 2001), second only to lung cancer. Approximately 40,800 women were projected to die as a direct result of breast cancer in 2001 (NCI, 2001). According to the American Cancer Society (2001) approximately 193,700 women were estimated to be diagnosed with new cases of invasive breast cancer in 2001 (ACS, 2001).

The incidence of breast cancer has fluctuated over the last 30 years, mainly due to increased and improved breast cancer screening (Howe et al., 2001). Table 1 illustrates breast cancer incidence rates and trends for all women, as well as Caucasian and African-American women. Howe and colleagues (2001) report that the annual percentage change in breast cancer incidence rates for all women during the period was 1.2%. From 1973 to 1980, the annual percentage change in breast cancer incidence decreased by 0.7%. However, Betsill, Byrd and Hartman (1975) report that a rapid increase in breast cancer incidence occurred in 1974-1975 with more diagnoses occurring as a result of the publicity surrounding the breast cancer diagnoses of former first lady Elizabeth (Betty) Ford and Margaretta (Happy) Rockefeller, the wife of Vice-President Nelson A. Rockefeller.

Although breast cancer incidence has increased, a sustained reduction in breast cancer mortality of 1% per year has occurred since 1991 (NCI, 2001). Likewise, recent data also indicate a 2.4% decrease in the death rates from breast cancer for all women during the 1992 to 1998 period (Howe et al., 2001) with Caucasian women experiencing the largest reductions in mortality rates (see Table 2). Figure 1 graphically demonstrates the breast cancer incidence and death rates for both Caucasian and African-American women. Nonetheless, despite improvements in breast cancer mortality rates it is estimated that one woman in eight will develop breast cancer in her lifetime (Feuer et al., 1993). Because the lifetime risk is so large, considerable effort has been spent to determine the risk factors for breast cancer.

Table 1

Breast Cancer Incidence Rates and Trends, 1992-1998 and Joinpoint Analyses for 1973-1998

			Trend 1		Trend 2		Trend 3	
	Average annual rate* (1992-1998)	**APC† (1992-1998)**	**Range of years**	**APC†**	**Range of years**	**APC†**	**Range of years**	**APC†**
All women	111.2	1.2‡	1973-1980	-0.7	1980-1987	3.8‡	1987-1998	0.5
Caucasians	115.5	1.1‡	1973-1980	-0.6	1980-1987	3.9‡	1987-1998	0.4
African-Americans	101.5	0.1	1973-1979	-0.8	1979-1986	4.0‡	1986-1998	0.9‡

*Average annual rate is calculated per 100,000 women.
†APC = annual percentage change.
‡APC is statistically significantly different from zero (two-sided $p < .05$).
Source: Adapted from Howe et al., 2001. Used with permission of publisher.

Table 2

Breast Cancer Death Rates and Trends, 1992-1998 and Joinpoint Analyses for 1973-1998

			Joinpoint analyses (1973-1998)							
			Trend 1		Trend 2		Trend 3		Trend 4	
	Average annual rate* (1992-1998)	APC† (1992-1998)	Range of Years	APC†	Range of Years	APC†	Range of Years	APC†	Range of Years	APC†
All women	24.7	-2.4‡	1973-1979	-0.3	1979-1989	0.5‡	1989-1995	-1.6‡	1995-1998	-3.4‡
Caucasians	24.3	-2.7‡	1973-1990	0.2‡	1990-1995	-2.0‡	1995-1998	-3.6‡		
African-Americans	31.0	-0.6	1973-1991	1.3‡	1991-1998	-0.6				

*Average annual rate is calculated per 100,000 women.
†APC = annual percentage change.
‡APC is statistically significantly different from zero (two-sided $p < .05$).
No trend analysis was performed when there were too few cases in any year.

Source: Adapted from Howe et al., 2001. Used with permission of Oxford University Press.

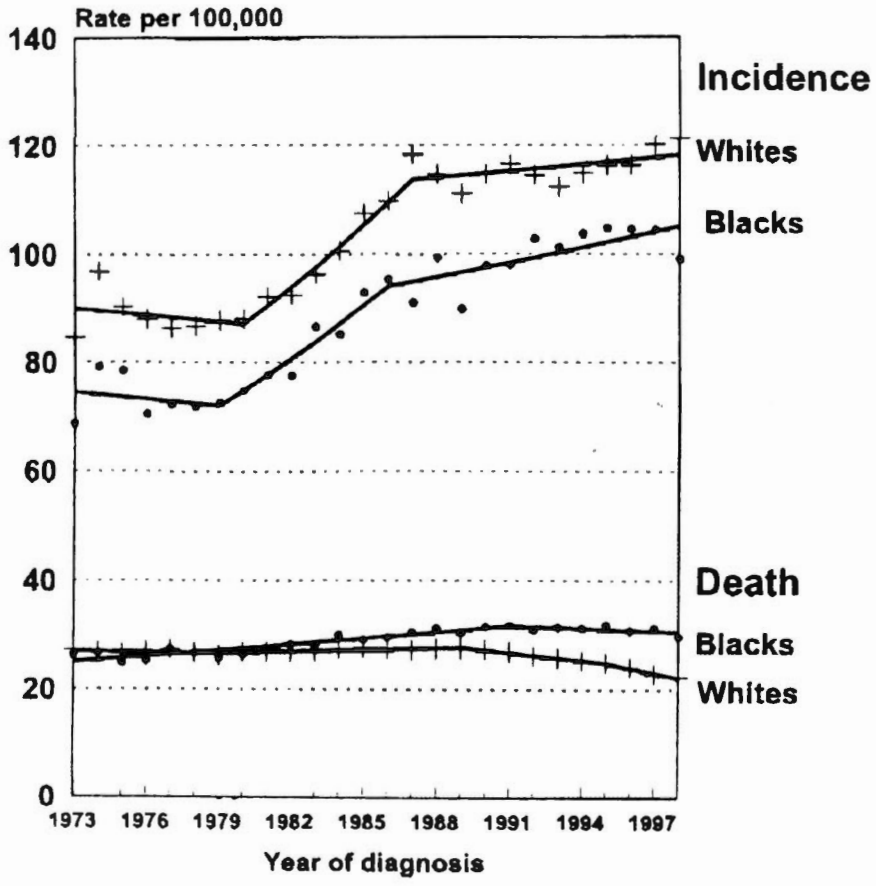

Figure 1. Female breast cancer incidence and death rates* by race (Whites and Blacks), 1973-1998.

*Rates are per 100,000 females and are age-adjusted to the 1980 U.S. standard million population.

Reproduced from Howe et al., (2001) with permission of Oxford University Press.

Risk Factors

Factors associated with breast cancer include those associated with the aging process, demographic, reproductive, and lifestyle factors. Relevant risk factors for women are summarized in Table 3. The most significant factor associated with breast cancer is that it occurs more as age increases. The likelihood of being diagnosed with breast cancer increases as one ages, with approximately two-thirds of breast cancers occurring in women ≥ 55 years (Ries et al., 2000). For example, only one woman in 217 will be diagnosed with breast cancer by age 40. By age 60, however, 1 woman in 24 will develop breast cancer (Harvard Health Publications, 2000).

Additional *demographic* factors that may contribute to risk of breast cancer include a first-degree relative with diagnosed breast cancer (i.e., mother, daughter, and/or sister) as well as a personal history of breast cancer. Women with a first-degree relative with breast cancer are 1.5 to 2.0 times more likely to have breast cancer (Dow, 1997; Harvard Health Publications, 2000). In some, the inherited susceptibility to breast cancer is due to genetic factors. Currently, two genes have been identified to be linked with breast cancer: BRCA1 and BRCA2. Inherited breast cancers cause approximately 10% of the breast cancers. The mutated BRCA1 gene is estimated to account for half of the inherited cancers; the BRCA2 gene accounts for one-fourth (Harvard Health Publications, 2000; McPherson, Steel, & Dixon, 2000).

Previous personal history of malignant or benign breast disease also is a significant factor for potential breast cancer development. Women with a previous history of breast cancer have a 1% greater chance per year of developing breast cancer in

Table 3

Risk Factors Associated with Breast Cancer in Women (all ages)

Category	Risk Factor
Demographic	Age
	Family history of breast cancer
	Personal history of breast cancer
	Race/ethnicity (nonCaucasians)
	Socioeconomic group (i.e., lower income)
Reproductive	Early age at menarche (i.e., before age 12 years)
	Later age at birth of the first child
	Late age of menopause (i.e., after age 50 to 55 years)
	Prolonged exposure to cyclic estrogens (e.g., diethylstilbestrol)
Lifestyle factors	Alcohol consumption
	High fat diet
	Obesity
	Smoking
	Sedentary lifestyle

the opposite breast (Dow, 1997; Harvard Health Publications, 2000). Race also represents an important demographic factor influencing the development of breast cancer. Caucasian women have the highest incidence for developing breast cancer, followed closely by African-American women. Asian, Hispanic, and Native-American women demonstrate lower incidences of breast cancer. Figure 2 displays both the breast cancer incidence and mortality rates for various racial and ethnic groups in the U.S. during the 1992 to 1998 period. For example, the breast cancer incidence per 100,000 women (from 1992 to 1998) was 115.5 for white, nonHispanics; African-Americans' incidence was 101.5; incidence for Hispanic women was 68.5; Asian/Pacific Islanders and Native Americans had incidences 78.1 and 50.5 per 100,000 women, respectively (Howe et al., 2001).

Factors involving a woman's *reproductive capacity* include: early age at menarche (i.e., before age 12 years), later age at birth of the first child, late age of menopause (i.e., after age 50 to 55 years), and prolonged exposure to cyclic estrogens (e.g., diethylstilbestrol) (Dow, 1997; Harvard Health Publications, 2000; McPherson, Steel, & Dixon, 2000).

Risk factors involving an individual's *lifestyle* have also been established. Women who consume one or more alcoholic drinks per day are at a slightly increased risk of breast cancer (Dow, 1997). A weak association between high-fat dietary intake has been discussed in the literature, although debate exists as to the validity of these findings (Dow, 1997). Related to diet, weight/obesity is a risk factor. Weight gain is linked to an increase in the risk of breast cancer for all postmenopausal women. For example, women

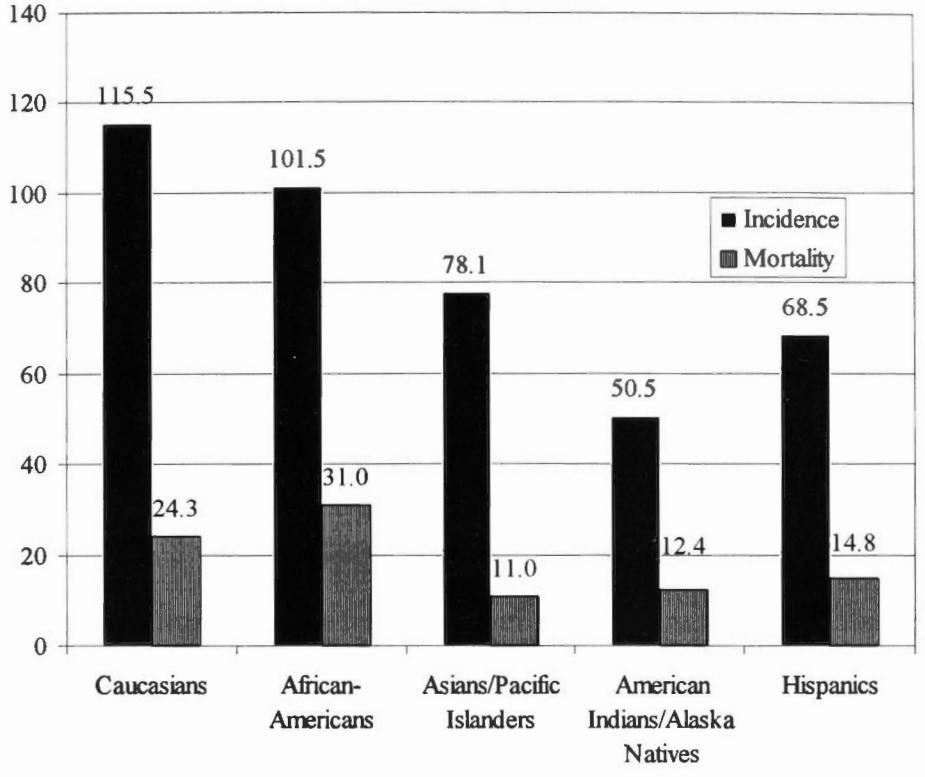

Figure 2. Breast cancer incidence and mortality by race/ethnicity, 1992-1998*.

*Rates are per 100,000 women and are age-adjusted to the 1970 U.S. standard million population.

Source: Adapted from Howe et al., 2001. Used with permission of Oxford University Press.

who gained more than 45 pounds since age 18 years have a slightly higher risk of developing breast cancer.

Last, a relationship between lack of exercise and breast cancer risk appears to exist. Some studies indicate that women who live a sedentary lifestyle are at increased risk of breast cancer (Harvard Health Publications, 2000). Conversely, women who participated in vigorous exercise were at lower risk for developing breast cancer. However, this association between exercise and decreased breast cancer risk may be an interaction between various risk factors. For example, a delay in the onset of menstruation for young women who frequently exercise is reported. Thus, they avoid the risk factor of early age at menarche. In addition, exercise may also aid in the control of ones' weight and help to avoid the risk factor of obesity (Harvard Health Publications, 2000).

Because the majority of established risk factors and demographic characteristics associated with breast cancer are nonmodifiable (i.e., aging, reproductive, and some demographic factors), emphasis has been placed on the early detection and diagnosis of the disease. Early detection is more compelling considering that approximately 60% of women diagnosed with breast cancer do not have any factors placing them at high risk for the disease. Therefore, all women should be considered at risk for developing breast cancer during their lifetimes (Dow, 1997).

Screening and Early Detection Methods

Currently, the best methods for screening and early detection of breast cancer include physical examination combined with radiologic imaging of the breast. The three

screening and early detection methods are breast self-examination, clinical breast examination, and mammography. Breast self-examination (BSE) is a physical examination of the breasts conducted by the individual. The ACS recommends monthly BSE for women ≥ 20 years, according to established methods. BSE is often considered a first-line defense for the early detection of the disease; however, debate exists as to the effectiveness and proficiency of the examination conducted by the individual (Dow, 1997).

Clinical breast examination (CBE) is also a physical examination of the breast conducted by a trained individual. A CBE every three years is recommended for women ages 20 to 40; annual CBE is recommended for women ≥ 40 years (Dow, 1997). Of the three early detection methods, mammography is the most effective. An in-depth discussion of mammography follows.

Overview of Mammography

Mammography (also known as film/screen mammography) is the imaging of the breast tissue using radiation and an image recording medium (i.e., radiographic film or digital detector). Breast imaging began in the early 20th century with general radiographic equipment. Since the 1960s, however, technological advancements and innovations have improved mammography techniques and procedures (Legg, 1999), including radiation dose reduction and the use of breast compression. In the 1980s, dedicated mammography machines replaced the general radiographic equipment (U.S. DHHS, 1994).

The examination is commonly conducted in radiology departments in hospitals and imaging centers. The standard examination consists of two views of each breast. A compression plate is employed during the examination to compress the breast tissue to a uniform thickness. Consequently, the patient may experience some discomfort. Mammography examinations are divided into two types: screening and diagnostic. Screening mammography is a procedure performed to detect unsuspected breast cancer in asymptomatic women. Diagnostic mammography, however, is a procedure conducted to evaluate abnormal physical or radiographic findings (U.S. DHHS, 1994). Since preventive care is the emphasis of this study, discussion of mammography will refer to screening mammography, unless otherwise indicated.

Mammography is the most effective method of detecting and diagnosing breast cancer with estimated sensitivities for detecting breast cancer ranging from 76 to 94% (ACS, 1997). Sensitivities of 54% to 58% in women < 40 years and 81% to 94% in those women > 65 years are also reported (Kerlikowske et al., 1996; Rosenberg et al., 1998). The efficacy of mammography is based on conclusions from national and international randomized controlled trials (RCTs). The RCTs include the Health Insurance Plan study (conducted in the U.S.), Swedish Two-County (Nyström et al., 1993; Tabár et al., 1992; Tabár, Faberberg, & Holmberg, 1987), Malmö (Andersson et al., 1988), Gothenburg, and Stockholm Studies, and the Canadian National Breast Screening Studies 1 and 2 (NBSS 1 and 2) (Miller, Baines, To, & Wall, 1992a; Miller, Baines, To, & Wall, 1992b).

Results of RCTs in the U.S. and Europe clearly indicate that use mammography for early detection can reduce breast cancer mortality by 20% to 40% for women ≥ 50

years. Evidence of efficacy for women ages 40 to 49 is less clear, although many studies report significantly decreased mortality after approximately 10 years of follow-up. Despite differences in study sizes and risk ratios for all the clinical trials, a consistent reduction of approximately 25% to 30% in breast cancer mortality for women of all ages in the study groups receiving regular mammography screening is demonstrated. These conclusions are supported by a meta-analysis of 13 studies reported from 1966 to 1993 in which Kerlikowske and colleagues (1995) posit that the judicious utilization of mammography can prevent approximately one-fourth of the breast cancer deaths.

Mammography is a cost-effective method for breast cancer detection and prevention. Salzmann, Kerlikowske, and Phillips (1997) determined the cost-effectiveness of biennial mammography screening for women ages 50 to 69 years using Markov and Monte Carlo models. Compared with no mammographic screening, a biennial screening program for 10,000 women ages 50 to 69 years was estimated to yield an additional 329 years of life. The financial cost was equated at $704 per individual. The cost-effectiveness of screening women in the 50 to 69 year old age group was estimated at $21,400 per year of life (YLS) saved. In general, preventive health interventions that cost < $50,000 per YLS are viewed as favorable (Laupacis, Feeny, Detsky, & Tugwell, 1992). Therefore, mammography in this age cohort should be considered cost-effective intervention as compared to no screening.

Mammography Guidelines

Recommendations regarding the frequency and age ranges for performing mammography remain a source of debate in the U.S. Currently, a majority of national

organizations and physician specialty groups recommend annual mammography for women ≥ 50 years.

However, less agreement is found regarding mammography recommendations for women ages 40 to 49 years. Questions about the scientific evidence for mammography in women ages 40 to 49 years--and the resulting controversy--have received considerable attention in the general media (Kolata, 1997) and medical journals (Fletcher, 1997; Pauker & Kassirer, 1997). Nonetheless, differences persist in the recommendations on frequency of mammography for the age cohort. Currently, the ACS, AMA, and ACR recommend annual mammography for women ages 40 to 49 years old. The ACOG and NIH recommend mammography every one to two years. Kolata (1997), a vehement critic of the NIH's failure to recommend annual screening for the 40 to 49 year cohort, considers it "tantamount to a death sentence" (p. C1).

Unfortunately, the debate has had a negative effect on women's understanding of mammography recommendations. Woloshin and colleagues' (2000) survey of women's (n = 503) understanding of the debate on mammography recommendations reveals a negative effect. Only 24% of the respondents stated that the recent discussion on mammography recommendations had improved their understanding of mammography. Nearly one-half report being upset by the public disagreement among experts.

Benefit of Early Detection

Early detection of breast cancer is important because prognoses improve and survival rates increase if the disease in detected in its early stages. According to Parker, Tong, Bolden, and Wingo (1996), the 5-year survival rate for women with localized

cancer (i.e., that has not spread to other parts of the body) is 97%. However, 5-year survival rates are not equal among racial groups. African-American women have lower survival rates compared with Caucasian women (see Figure 1). According to NCI Surveillance, Epidemiology, and End Results statistics, the 5-year survival rate for all stages of breast cancer (1989 to 1996) was 86.4% for white women and 71.4% for African-American women (Ries et al., 2000). Survival rates dropped drastically to 20% for women with distant metastases (Parker, Tong, Bolden, & Wingo, 1996). Spread of breast cancer may account for mortality differences by race; a higher proportion of African-American women had regional and distant spread of cancers at initial diagnosis as compared to Caucasians (Eley et al., 1994; Ries et al., 2000). Mortality differences by race may be due to the time of initial diagnosis (i.e., early stage versus later staged cancers). Therefore, early detection of breast cancer results in a better prognosis compared to cancers diagnosed at later stages (Parker, Tong, Bolden, & Wingo, 1996).

Future Detection/Prevention Methods

Although film/screen mammography remains the 'gold standard' method for detecting breast cancer, other imaging and nonimaging techniques are emerging at the time of this study. Digital mammography represents a departure from the film-screen recording of mammographic images. The traditional film and film-holder (cassette) are replaced with a digital (i.e., electronic) detector. The anatomic information is recorded electronically with the digital detectors and can be displayed on special computer monitors. Benefits of digital mammography include image manipulation as well as

opportunities for digital subtraction, and computer aided diagnosis (Pisano & Parham, 2000).

Magnetic resonance (MR) imaging is finding increased application in breast imaging. This imaging technique uses radio waves and magnetic fields to create images of the body. MR breast imaging has demonstrated encouraging results in initial clinical testing (Orel & Schnall, 2001; Warner et al., 2001). However, concerns regarding cost and cost-effectiveness exist (Orel & Schnall, 2001).

Positron emission tomography (PET) of the breast involves the injection of radioactive pharmaceutical agents into the patient's bloodstream. These agents allow for visualization of cancerous tissue, such as breast cancer. PET imaging is currently undergoing evaluation in its ability to accurately stage breast cancers (Jochelson, 2001). Overall, studies involving radiologic phantoms (Raylman et al., 2000) and human subjects demonstrate encouraging results (Eubank et al., 2001; Murthy et al., 2000).

In addition to these detection methods, newer nonimaging techniques for the early detection breast cancer focus on hereditary factors and chemoprevention. Genetic testing for the presence of BRCA genes can provide critical information for breast cancer surveillance. Although concerns exists the diagnosis of genetic anomalies could potentially impact one's ability to obtain health or life insurance, Stephanson (1999) believes these fears are largely unfounded. Nonetheless, genetic testing for cancer will continue garner attention in the health care research and policy arenas.

Chemopreventive agents are based on genetic testing. Chemopreventives aid in breast cancer prevention by blocking the effects of estrogen in the breast and uterus.

However, these drugs mimic estrogen's positive effects for the bone and heart (Harvard Health Publications, 2000). Two engineered drugs utilized for breast cancer prevention are tamoxifin nitrate and raloxifene hydrochloride. Although the efficacy of these drugs continues to be evaluated, concern exists for their general use considering that it is not possible to determine with certainty who will develop breast cancer (Harvard Health Publications, 2000). Despite advances in early detection and prevention, mammography remains the most effective early detection method at the time of publication.

Overview of Disability in the U.S.

Americans with disabilities represent a large segment of American society. Complicating any study of health care utilization of disabled persons are the various broad definitions of disability. To achieve an acceptable operational definition of disability for this study, the following sections will discuss definitions of disability used by various organizations and authors. In addition, the types and incidences of disability are discussed. Finally, important health research findings involving persons with disabilities are discussed to better understand this U.S. subpopulation and the factors that influence their utilization of mammography.

Defining Disability

No standard classification system exists for defining disability. The Institute of Medicine's Committee on National Agenda for the Prevention of Disability (Pope & Tarlov, 1991) defines disability as limitations in function as compared to expected ability. Either a disease/condition or impairment may cause the limitation. Impairment includes loss in mental, physiological, or anatomical structure or function. The Americans with

Disabilities Act of 1990 (ADA), a monumental legislative act to increase the employment rate of people with disabilities and improve the lives of the American disabled population, defines disability slightly differently.

In the ADA, disability is defined as a physical or mental impairment that *substantially* limits one or more of the *major life activities*. Physical impairment includes any physiological disorder or condition, cosmetic disfigurement, or anatomical loss that affects a major body system (Hablutzel & McMahon, 1998). Mental impairment represents any mental or psychological disorder and includes conditions such as mental retardation, organic brain syndrome, emotional or mental illness, and specific learning disabilities (Hablutzel & McMahon, 1998). An essential component of the ADA definition is the qualification of "substantial" and "major life activity" (LaPlante, 1992). The presence of a physical or mental impairment does not constitute a disability unless a substantial limitation in one or more life activities exists. These major life activities include; self-care, walking, seeing, learning, speaking, breathing, learning, working, and participation in community activities (H.R. Rep. No. 485, 1990).

The definition of disability used by the U.S. Census Bureau (U.S. Department of Commerce, 1997) is similar to that of the ADA. Disability in adults is defined as those persons 15 years old and older who meet any of the following criteria:

- used a wheelchair or were a long-term user of a cane, crutches, or a walker,
- had difficulty performing one or more functional activities (seeing, hearing, speaking, lifting/carrying, going up stairs, or walking),

- had difficulty with one or more activities of daily living (i.e., getting around inside the home, getting in or out of bed or a chair, bathing, dressing, eating, and toileting),
- had difficulty with one or more instrumental activities of daily living (i.e., going outside the home, keeping track of money and bills, preparing meals, doing light house-work, taking prescription medicines in the right amount at the right time, and using the telephone),
- had one or more specified conditions (e.g., a learning disability, mental retardation or another developmental disability, Alzheimer's disease, or some other type of mental or emotional condition).

The operational definitions of disability may also differ in federal agencies' national surveys and data collection programs. According to Kaye, LaPlante, Carlson, and Wenger (1996), disability data have been available in the NHIS since 1970. However, a substantial change in the 1982 NHIS questionnaire altered the estimated disability rate beginning in 1983. Therefore, caution is warranted when comparing any pre- to post-1983 disability data from the NHIS.

The NHIS defines disability as limitations in activity due to chronic health conditions and impairments. Information is collected on self-reported limitations in functioning, ability to work, and cognitive ability. During the survey, self-reported limitations in activities of daily living (ADLs) and instrumental activities of daily living (IADLs) are identified and categorized as well as one's mobility without the use of assistive devices (NCHS, 2000). The NHIS also obtains self-reported information on the individual's "ability to perform major activity," defined as working or keeping house for

the 18 to 69 year old cohort. Major activity for persons 70 years and older is defined as self-care and independence (Adams, Hendershot, & Marano, 1999; NCHS, 2000).

Information on the disabled U.S. population is also obtained from the Agency for Health Research and Quality's (AHRQ) Medical Expenditure Panel Survey (MEPS). The MEPS panel forms a representative sample of the U.S. noninstitutionalized population. Disability data includes self-reported health and mental status, ADLs, IADLs, and use of assistive equipment/devices (AHRQ, 2001).

Last, the MCBS, conducted by CMS' Office of Strategic Planning, also includes disability-related questions for the Medicare-enrolled population. In this data set, disability-related questions pertain to the presence of self-reported ADLs, IADLs, and health and cognitive status/limitations. The health conditions that cause the functional and cognitive limitations are also recorded during various rounds of the survey.

In summary, no standard definition or system exists for classifying disability. However, a consistent feature of many definitions of disability is the presence of *limitation in activity or function* caused by a chronic condition or impairment of physiological or psychological origin (LaPlante, 1992). The limitations in activity represent long-term reductions in the ability or capacity to perform activities (LaPlante, Rice, & Kraus, 1991). Limitations in *cognitive* ability and one's ability to *work* are also encountered in the literature.

Prevalence

Estimates of the number of disabled persons in the U.S. vary due to the different operational definitions used to denote disability. The most recent disability estimates

from the U.S. Bureau of the Census and Center for Disease Control and Prevention (CDC) are based on the Survey of Income and Program Participation (SIPP) (McNeil & Binette, 2001). The 1996 SIPP is a multistage stratified sample of the U.S. noninstitutionalized, civilian population. Members of the study panel were interviewed 12 times over a 4-year period. Specific information on disability was acquired in 1999 via the Adult Disability Topical Module of Wave 11. Information on self-reported disability was collected in 36,700 households representative of the U.S. population ≥15 years.

Disability is defined as self- or proxy-reported disability according to the U.S. Census Bureau. In addition, the following conditions were included: the limitation in the ability to work at a job or business and the receipt of federal benefits due to the inability to work. Based on analysis of adults ≥ 18 years (n = 53,636), it was estimated that 44 million adults had a disability in 1999, representing 22% of the total population (McNeil & Binette, 2001), as reported in Table 4.

The largest group of disabled persons consisted of those having difficulty with specified functional activities, consisting of approximately 32 million adults. Approximately 11 million persons reported IADL limitations and almost 7.7 million reported difficulties with one or more ADL (McNeil & Binette, 2001). An interesting finding is that the majority of people ≥18 years reporting a disability were working adults; 63% of the self-reported disabilities and limitations occurred among persons who reported current employment.

Table 4

Number and Prevalence Rates of Civilian Noninstitutionalized Persons Ages > 18 Years With Selected Disabilities, By Age Group- Survey of Income Program and and Participation, U.S., 1999

	Persons with Disabilities					
Measure of Disability	**≥ 18 years**		**18-64 Years**		**> 65 Years**	
	No.†	**Rate***	**No.†**	**Rate***	**No.†**	**Rate***
Functional activities‡	32,191	16.0	17,110	10.2	15,081	46.3
ADLs	7,690	3.8	3,514	2.1	4,176	12.8
IADLs	11,795	5.9	5,370	3.2	6,425	19.7
Ability to work at job/business	n/a	n/a	17,689	10.5	n/a	n/a
Alzheimer disease/ senility/dementia	1,684	0.8	509	0.3	1,175	3.6

*Per 100 person calculated using the civilian, noninstitutionalized U.S. population on July 1, 1999.

†In thousands

‡Functional activities include: ability to see words or letters in ordinary newspaper print, hear normal conversations, have speech understood by others, lift/carry 10 lbs., climb a flight of stairs without resting, and walk three city blocks.

Source: Adapted from McNeil & Binette (2001). Used with the permission of the publisher.

The proportion of the U.S. population with disabilities has risen markedly during the past 25 years (Kaye, LaPlante, Carlson, & Wenger, 1996). The proportion of disabled persons in the general population rose from 11.7% in 1970 to 14.4% in 1981.

Following the 1982 NHIS questionnaire change, the disability rate remained constant at approximately 14.0% and then rapidly increased (beginning in 1990) to a high of 15.0% in 1994. The prevalence of disabilities has increased due to two trends, according to Kaye, LaPlante, Carlson, and Wenger (1996). First, the aging of the U.S. population has caused an increase in the proportion of disabled persons. Second, the rapid increase in the disability rate is due to a marked increase in the numbers of children and young adults with reported disabilities.

However, an alternate conclusion is drawn by Cutler (2001). Based on his analysis of several national studies on disability and aging (e.g., National Long-Term Care Survey, NHIS-National Nursing Home Survey, Survey of Income and Program Participation, and the Medicare Current Beneficiary Survey), he concludes that the proportion of elderly who are dependent (i.e., limitations in activities of daily living and instrumental activities of daily living) or have functional limitations (i.e., physical or sensory impairments) declined between 1984 and 1999. Cutler posits that declining disability is based on improvements in health behaviors, medical care, and socioeconomic status among the elderly. Differences in prevalence of disabilities among various authors may be due to operational definitions of disability and limitations as well as analysis of data from different years.

Last, cognitive limitations or problems may also cause functional disabilities. For example, Alzheimer's disease affects the mental functioning and behavior of the stricken individual and eventually affects various physiological systems. The Alzheimer's Association (n.d.) estimates that 25% of persons ≥ 85 years have Alzheimer's disease or a related dementia. Overall, approximately 2 million people in the U.S. suffer from cognitive decline due to dementia (Advisory Panel on Alzheimer's Disease, 1993).

Causes of Disability

This section reviews the health disorders, injuries, or impairments causing disability in the U.S. population. *Health disorders* are defined medical diseases or conditions that affect physiological functioning (e.g., cancer, asthma). *Injuries* are external events that cause harm to the body (e.g., motor vehicle accident) and, *impairments* are "deficits of bodily structure or function, either congenital in origin or acquired from a past or ongoing disorder or injury" (LaPlante, 1996, p. 1). Examples of impairments include deficits of senses (i.e., vision, hearing, or sensation), absence of limbs or other body parts, and learning disabilities (LaPlante, 1996).

The majority of disabilities in the U.S. are caused by health disorders and injuries. Using data from the 1992 NHIS, LaPlante (1996) analyzed self-reported conditions causing disability. The classification scheme for impairments used by LaPlante were based on the NCHS classification system for disability and, health disorders and injuries were coded to the World Health Organization's International Classification of Disease, Ninth Revision. Nonetheless, the classification of impairments can affect the accurate estimation of the causes of impairments. Some individuals' conditions may be double-

counted although they arise from one condition. As an illustration, LaPlante offers the example of a person who has had a leg amputation due to bone cancer that is still active at the time of the survey. Both the absence of the limb (impairment) and the cancer (health disorder) are coded separately. Other classification or coding problems may arise due to the interviewer's coding of the condition based on the respondent's description of the disability. Despite these concerns, the data do provide valuable knowledge of the health conditions and impairments causing disability.

Using the 1992 NHIS, LaPlante (1996) estimated that 37.7 million people reported activity limitations at an average of 1.6 conditions per person (see Table 5). system (e.g., asthma) (7.8%), nervous system and sense organs (7.2%), and conditions originating during the perinatal period (4.7%). Impairments caused slightly more than one-fourth of the disabilities (26.7%) according to 1992 NHIS data. Orthopedic impairments comprised 14.1% of impairments. Other causes of impairment were less common. Examples include learning disabilities and mental retardation (2.6%), impairments to vision (2.6%) and hearing (1.9%), and paralysis (1.8%).

Selected Characteristics of the Disabled Population

An estimated 26 million women live with disabilities in the U.S. (McNeil, 1993). According to Welner (1998), women with disabilities are among the more disadvantaged groups in society due to the interrelation between disability and age, socioeconomic status, and race. To illustrate the overall disadvantaged status of disabled persons--especially women--additional information on demographic, socioeconomic, and health care utilization/expenditures are discussed.

Table 5

Conditions Causing Disability by Disease and Impairment Categories

Conditions	Number (in 1,000s)	Percentage
All Disabling Conditions	61,047	100.0
Disorders and Injuries	44,721	73.3
Musculoskeletal disease	10,530	17.2
Circulatory disease	10,170	16.7
Respiratory disease	4,774	7.8
Nervous system/sense organ disease	4,373	7.2
Endocrine, nutritional, metabolic, disease and immunity disorders	3,409	5.6
Conditions originating in perinatal period	2,843	4.7
Mental disorders, excluding mental retardation	2,035	3.3
Digestive system disease	1,728	2.8
Neoplasms	1,628	2.7
Other disorders and injuries	3,227	5.4

Table 5 (continued)

Conditions	Number (in 1,000s)	Percentage
Impairments	16,326	27.6
Orthopedic impairments	8,608	14.1
Learning disability and mental retardation	1,575	2.6
Deformities	900	1.5
Absence/loss of limb/other body part	788	1.3
Speech impairments	545	0.9
Other/ill-defined impairments	371	0.6

Note: Condition categories are not mutually exclusive.
Source: Adapted from LaPlante (1996). Used with permission.

A consistent finding is the association between gender and disability. The proportion of women identified as disabled has consistently been greater than men (Bradsher, 1996; LaPlante, Rice, & Kraus, 1991; McNeil & Binette, 2001; Merrill, Seeman, Kasl, & Berkman, 1997), although some of the reported differences are not statistically significant. Using data from the 1999 wave of the SIPP (n = 53,636), McNeil and Binette (2001) calculate that the proportion of self-reported disability in the U.S. population is higher for women (24%) than for men (20%). Verbrugge (1998) offers a rationale for the larger proportion of disabled women as compared to men. Verbrugge posits that women's longer life expectancies increases the opportunity for acquiring chronic diseases that ultimately result in functional limitations.

The likelihood of a severe disability increases with age (LaPlante, Rice, & Kraus, 1991; McNeil, 1997). The proportion of the U.S. population ages 45 to 54 years that is classified as disabled is estimated at 24.5%, with 11.5% of this age cohort classified as severely disabled. Slightly more than one-fourth (26.3%) of persons ages 55 to 64 are disabled; 21.9% are classified as severely disabled. Approximately one-half (47.3%) of the 65 to 79 year cohort are disabled, 27.8% classified as severely disability. The ≥ 80 year age group demonstrates the highest proportion of disability (71.5%) with over one-half of the age cohort (53.5%) being severely disabled (McNeil, 1997).

Approximately 73.3% of all disabilities were caused by health disorders and injuries including diseases of the musculoskeletal system and connective tissue (e.g., arthritis, rheumatism) (17.2% of total), circulatory system (e.g., heart disease) (16.7%), respiratory classified as disabled is estimated at 24.5%, with 11.5% of this age cohort

being classified as severely disabled. Slightly more than one-fourth (26.3%) of persons ages 55 to 64 are disabled; 21.9% are classified as severely disabled. Approximately one-half (47.3%) of the 65 to 79 year cohort are disabled, 27.8% classified as severely disability. The ≥ 80 year age group demonstrates the highest proportion of disability (71.5%) with over one-half of the age cohort (53.5%) being severely disabled (McNeil, 1997).

Likewise, a strong association exists between gender, age, and disability status. Because women have a higher average life expectancy as compared to men (NCHS, 1994), they are more likely to be disabled when elderly. A slightly higher percentage of female Medicare beneficiaries (39%) report limitations due to chronic conditions as compared to males (37%). Elderly women were also more likely to report ADL and major life activities as compared to men (Rice, 1996).

Disability rates differ among racial and ethnic groups. In general, greater proportions of minority women are disabled as compared to Caucasian women (see Table 6) (Bradsher, 1996; Kennedy & LaPlante, 1997; LaPlante & Carlson, 1996). The disability rate for female Caucasians (15 to 64 years) is 17.5%. A greater proportion of African-American (22.0%) and Native-American (28.7%) women in the same age cohort are classified as disabled. Asian/Pacific Islander women and Hispanic women have the lowest rates of disability among minorities (9.9% and 17.6%, respectively) (Bradsher, 1996). Noted is the lower rate of disability of Asian/Pacific Islander women; their rates are even lower than Caucasian women. Similarly, Ostchega and colleagues (2000) report a higher prevalence of disability among older Mexican-Americans as compared to

Table 6

Disability Prevalence Among Women, Ages 15-64, by Race/Ethnicity, 1991-1992

Race/Ethnicity	Percentage
Caucasian	17.5
African-American	22.0
Native American	28.7
Asian/Pacific Islander	9.9
Hispanic	17.6

Source: Adapted from Bradsher (1996). Used with permission.

Caucasians. Using data from the 1988-1994 Third National Health and Nutrition Examination Survey, Mexican-American and nonHispanic black women ≥ 60 years (n = 6,866) reported a significantly greater proportion of self-reported limitations and disability than nonHispanic Caucasians ($p < .01$).

An association between socioeconomic status (SES) and disability among women has been reported in the literature (LaPlante, Rice, & Kraus, 1991). Disabled women have lower incomes as compared to their nondisabled cohorts (Kaye, 1997; Kington & Smith, 1997; NCHS, 1998). Disabled persons are more likely to hold part-time jobs and, therefore, earn less money than those employed full-time. Yet, despite differences in part and full-time employment status, the income differentials between the disabled and nondisabled remain. Based on 1995 data, women with disabilities earned 13% less than did nondisabled women. Disabled women's monthly income was $1,511 as compared to $1,737 for nondisabled women (Kaye, 1997). This difference is also similar among Medicare beneficiaries. Aged Medicare beneficiaries (i.e., ≥ 65 years) have a mean annual personal income of $13,306 as compared to $10,601 for disabled enrollees (i.e., < 65 years) (Wilcox-Gök, 2000). Longitudinal analysis of income differentials reveals that the gap is closing very slowly. Women with work-related disabilities earned 85% of the amount of nondisabled women in 1984. In 1995, the proportion increased to only 87% (Kaye, 1997).

The financial status of disabled persons is further affected by their higher medical expenditures as compared to their nondisabled cohorts. Although old, data from the 1987 National Medical Expenditure Survey reveals the disproportionate amount of medical

expenditures among disabled persons (see Table 7). In 1987, the disabled represented 17% of the population (approximately 33.8 million persons). However, they were responsible for nearly one-half (47%) of the approximately $160 billion spent on medical care. The annual per capita medical expenditures by disabled persons was four times as great as nondisabled persons. For example, disabled persons spent $4,692 annually compared to $1,086 by the nondisabled. Women with disabilities also had greater medical expenditures than nondisabled women across all age groups. Women ages 45 to 64 years with a disability spent $4,365 annually compared to $1,324 by nondisabled women. Women ≥ 65 years spent $6,226 annually while the nondisabled cohort had an average medical-related expenditure of $2,066 (Max, Rice, & Trupin, 1995).

The financial implications of higher medical expenditures for those with disabilities are not restricted to only the disabled individual. Altman, Cooper, and Cunningham (1999) indicate that the entire household may be affected. Families with a disabled family member have higher emotional and financial stress as compared to households without disabled members. The authors also find evidence of rationing of health care resources to meet the needs of disabled family members.

Although disabled persons have higher medical expenditures and health care utilization than do nondisabled persons, their use of many preventive health care services may be lower. Functional limitations may be a significant factor for the underutilization of mammography (Chan et al., 1999; Iezzoni, McCarthy, Davis, Siebens, 2000). Disabled women also underutilize services such as Pap smear screening. Chan

Table 7

Per Capita Medical Expenditures, Percent of Service Users who Have Disabilities, and Percent of Medical Expenditures for People with Disabilities, by Age and Gender, 1987

Age and Gender	Per Capita Medical Expenditures ($)		Percent of	
	With Disability	No Disability	Service Users	Expenditures
All ages	4,692	1,086	16.8	46.7
1-17 yrs.	1,660	676	8.5	18.5
18-44	3,148	1,001	9.0	23.8
45-64	5,108	1,346	23.8	54.3
65+	6,341	2,309	46.7	70.6
Males	4,961	965	15.6	48.6
1-17 yrs.	1,650	620	8.5	19.8
18-44	3,425	734	8.7	30.8
45-64	6,100	1,371	22.3	56.0
65+	6,525	2,640	44.3	66.3

Table 7 (continued)

Age and gender	Per capita medical expenditures ($)		Percent of	
	With disability	No disability	Service users	Expenditures
Females	4,495	1,191	17.9	45.2
1-17 yrs.	1,670	734	8.4	17.3
18-44	2,938	1,217	9.3	19.8
45-64	4,365	1,324	25.2	52.6
65+	6,226	2,066	48.3	73.8

Source: Max, Rice, & Trupin (1995). Used with permission of publisher.

and colleagues' (1999) analysis of data from the 1995 MCBS (n = 15,590) indicates that the more functional limitations reported by an individual, the less likely they were to report receiving a Pap test within the previous year ($p < .001$). However, they did not find that disabilities influenced the use of influenza and pneumococcal vaccinations. Lower use of preventive services among the disabled population may also be confounded by the lower SES experienced by this group.

Historically, disabled persons had fewer opportunities for accessing health care services, mainly due to financial barriers. Many lacked health insurance and were dependent upon segregated institutions or various state government or charity programs for health care. However, the amendment of Medicare in 1973 to include persons with disabilities enhanced access to health care for this underserved population (Master & Taniguchi, 1996). This entitlement expanded coverage to include disabled persons < 65 years. Since 1973, disabled persons have been the fastest growing population covered by Medicare (Davis & O'Brien, 1996; Master & Taniguchi, 1996). Disabled persons < 65 years receiving Medicare include individuals who receive Social Security Disability Income (SSDI) for 24 months, adults disabled as children (before age 22), and disabled widows and widowers (Davis & O'Brien, 1996; Rosenbach, 1995). Disabled Medicare beneficiaries < 65 years represent 12% of the total Medicare-enrolled population (i.e., 4.4 million persons) (Davis & O'Brien, 1996) with estimated health care expenditures of $15.9 billion in 1993.

Medicare does not cover all disabled persons. McNeil (1997) reports that 77.4% of disabled persons ages 22 to 64 years do not receive public assistance. Based on 1991

data, approximately one-fourth (3.7 million) of the estimated 14 million persons with severe disability < 65 years were eligible for Medicaid only. Less than one-half (47.9%) of this age cohort were eligible for both Medicare and Medicaid (Master & Taniguchi, 1996). Note that the disabled population < 65 years discussed in Master and Taniguchi's report is greater than previously reported for those receiving SSDI, due to the expanded definition of disability used by the authors.

The type of health coverage differs among the disabled population based on Wilcox-Gök's (2000) study of aged (i.e., ≥65 years) and disabled Medicare enrollees. Among aged enrollees, 76% have a supplemental private health insurance policy in addition to their Medicare coverage as compared to only 41% of disabled Medicare beneficiaries. Furthermore, a greater proportion of disabled Medicare enrollees also reported no coverage other than Medicare (37%) or were enrolled also in Medicaid (23%).

The disabled person's interaction with the health care system is different as compared to nondisabled persons, based on comparisons between disabled Medicare beneficiaries < 65 years and elderly beneficiaries ≥65 years. Wilcox-Gök's (2000) study of disabled and aged Medicare beneficiaries reveals that disabled Medicare enrollees utilize more types of medical care (i.e., doctor visits, emergency room visits, hospital visits, and prescriptions filled) than do aged enrollees. Disabled Medicare beneficiaries < 65 years experience more barriers to medical care than do other beneficiaries. They also report lower levels of satisfaction with the quality and costs of medical care (Rosenbach & Huber, 1993).

Variations in functional limitations by geographic region are reported in the literature, as indicated in Table 8. Higher proportions of persons with functional limitations reside in the South. For example, among persons reporting functional activity limitations, 15.2% live in the South as compared to the Northeast (13.1%), Midwest (13.7%), and West (13.5%) (LaPlante, Rice, & Kraus, 1991). LaPlante and colleagues report similar findings for other categories of disability; however, the differences are not as great. Rosenbach (1995) also reports that greater proportions of disabled Medicare beneficiaries reside in particular areas of the U.S. (e.g., South Atlantic [23.1%], Mid Atlantic [17.0%], and East North Central [17.9%] regions).

LaPlante, Rice, and Kraus (1991) also demonstrate differences in urban versus rural residency among the disabled population. Based on NHIS data, a greater proportion of disabled persons reside in rural areas as compared to metropolitan areas. Among persons limited in an activity, 16.6% reside in rural areas as compared to 13.3% residing in urban areas. Regardless of the type of limitation, rural residents had higher rates of activity limitations than their urban counterparts. Rosenbach (1995) reports that nearly one-third of disabled Medicare beneficiaries reside in rural locales. In summarizing the literature on disabled persons in the U.S., it is apparent that disabled women are more likely to be socioeconomically disadvantaged due to lower annual incomes, higher medical expenditures, and frequently less health insurance coverage than are nondisabled persons. Higher rates of disability are found in minority racial and ethnic groups (i.e., African- and Native-American), although mixed results are found in the disability rates

Table 8

Geographic Distribution of Disabled Medicare Beneficiaries by Census Division

Census division	Percent of disabled beneficiaries
New England	2.7
Mid Atlantic	17.0
East North Central	17.9
West North Central	5.4
South Atlantic	23.1
East South Central	8.6
West South Central	9.1
Mountain	5.6
Pacific	10.7

Source: Adapted from Rosenbach (1995). Used with permission of publisher.

for Hispanic- or Mexican-Americans. Nonetheless, these racial and ethnic groups demonstrate lower mammography rates as compared to Caucasian women.

As will be discussed in an ensuing section of Chapter 2, similarities exist between disabled women and other underserved groups that underutilize mammography. Therefore, this study seeks to determine the factors that influence mammography use by disabled women ≥ 50 years in the U.S. The utilization of a conceptual framework, such as the health services utilization model for health care utilization, allows for a more comprehensive examination of the various factors potentially influencing mammography use by disabled women by identifying essential dimensions and elements. An overview of the health services utilization model for health care utilization is discussed in the next section to better frame the review of factors influencing mammography utilization.

Conceptual Framework

The health services utilization model (Aday, Begley, Lairson, & Slater, 1998; Andersen, 1968; Andersen & Newman, 1973; Anderson & Davidson, 1999) was used to conceptualize the environmental, personal, and other factors that influence the use of mammography services among disabled and nondisabled women ≥ 50 years. In addition, other independent variables were incorporated based on the review of scholarly literature.

The health services utilization model (also known as Andersen's behavioral model) was developed and tested by Andersen in a 1964 nationwide interview survey sponsored by the Health Information Foundation and the National Opinion Research Center, University of Chicago. The original model was based on health care behavior literature from a variety of different disciplines, including sociology, economics,

psychology, and medicine. The resulting framework consisted of the delineation of predisposing, enabling, and need factors that predicted families' use of health care services (Aday & Awe, 1997; Andersen, 1968)

Over the past quarter decade, the health services utilization model has undergone revision, refinement, and empirical testing. The most current iteration is presented in Figure 3. Dimensions that influence the utilization of health care services include:

- environmental influences,
- population characteristics,
- health behaviors,
- and outcomes of health behaviors/health care.

These dimensions are theorized to be recursive in nature. For example, health behaviors (e.g., use of preventive health care and abstinence from smoking) may influence one's health outcomes. Conversely, health outcomes (e.g., weight loss) may further influence or stimulate health behaviors (e.g., healthy diet, frequent exercise, etc.).

The *environment* dimension refers to the external factors that affect the health of the individual in their communities. It also includes the characteristics of the health care system (Aday, Begley, Lairson, & Slater, 1998; Andersen & Davidson, 1999). *Population characteristics* refer to sociodemographic characteristics (e.g., age, residence in a rural area, marital status, education, race), enabling resources (e.g., presence of insurance and/or insurance type, income, etc.), and need (perceived or evaluated). Need

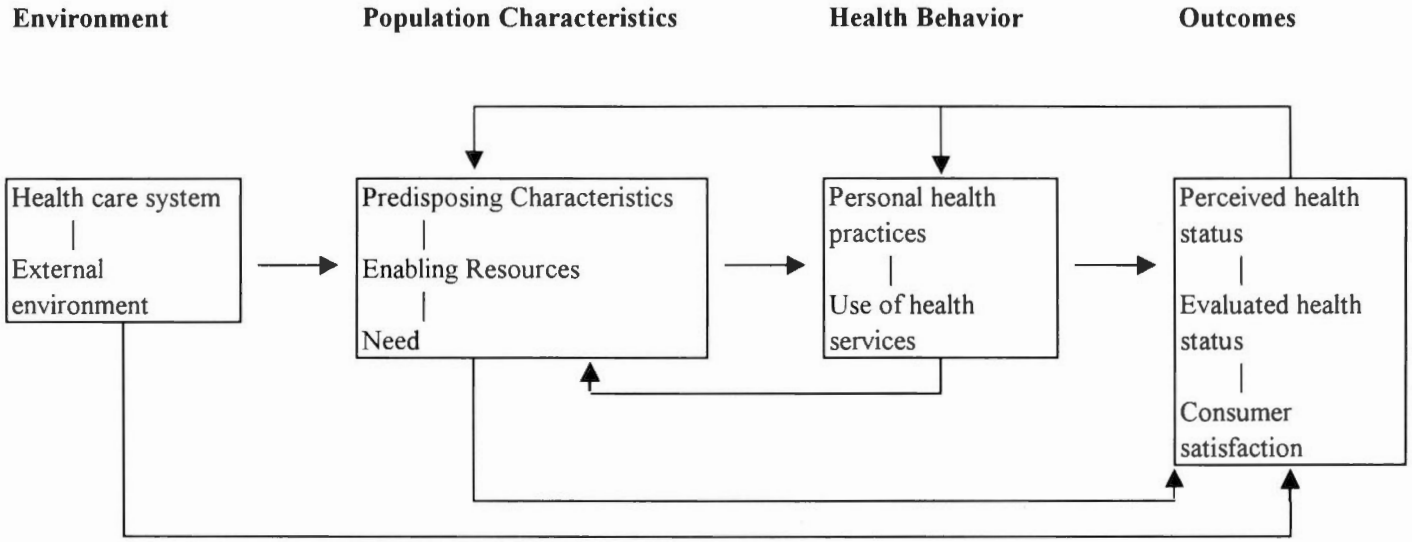

Figure 3. Health services utilization model (Andersen, 1995). Reproduced with permission of publisher.

as a characteristic of the population refers to the presence/perception of illness, conditions, or disease that serve as predictors of health service utilization. Various measures may be used to approximate the individual's need, including symptoms, disability days, self-reported health status. In addition, need may be evaluated by a health care provider via a diagnoses (i.e., professional judgement) for a particular health care complaint or symptoms (Aday & Awe, 1997; Aday, Begley, Lairson, & Slater, 1998; Andersen, 1968; Andersen & Davidson, 1999).

The *health behavior* dimension represents the individual's personal health practices and their use of formal health care services (Andersen & Davidson, 1999). Barriers to health care access, such as cost or transportation, are also included in this dimension as they can also affect health behaviors. Last, *health outcomes*, represent the impact (or lack thereof) of various factors (i.e., population characteristics, health behaviors, etc.) arising from the individual's medical care-seeking process. According to Andersen and Davidson (1999), outcomes include individuals' perceptions of their health status as well as clinical assessment(s) by a health care provider. For example, patients who undergo a surgical procedure should hopefully demonstrate improved health outcomes as measured by their self-reported and clinically-assessed health statuses. In addition, outcomes may include one's general satisfaction with the care received (Andersen & Davidson, 1999).

The health services utilization model has been used to study health care utilization (Andersen, Greeley, Kravits, & Anderson, 1972; Muller, 1986), access to services (Aday & Andersen, 1975), and equity among a variety of subject groups (Gilbert, Branch, &

Longmate, 1993; Miller & Champion, 1993; Padgett, Patrick, Burns, & Schlesinger, 1994). It is equitable access to mammography that is the focus of this study.

Access to health care is equitably or inequitably based on the factors or characteristics that predict an individual's realized (or actual) access (Andersen & Davidson, 1999). The factors include demographic characteristics (i.e., age, race, ethnicity, disability status) or enabling resources (i.e., income, insurance). Examining equity in health care seeks to determine if the benefits and burdens of medical care are fairly distributed throughout the population (Aday, Begley, Lairson, & Slater, 1998). Inequitable access exists when health services are distributed based on the demographic and enabling factors instead of need for services (Aday, Begley, Lairson, & Slater, 1998; Andersen & Davidson, 1999).

Mammography in the United States

This section of the literature review seeks to summarize the vast literature on mammography utilization in the U.S. It begins with a discussion of mammography utilization rates as determined by population-based studies. Later discussion focuses on factors that are positively and negatively associated with mammography utilization as well as the delineation of specific populations at-risk for underutilizing mammography.

Population-Based Studies

Many of the national estimates for mammography utilization in the U.S. originate from population-based studies. Population-based studies use individual-level data that can yield estimates for the total U.S. population or specific populations. A primary example of a database used for national population estimates of mammography use in the

U.S. is the National Health Interview Survey (NHIS). The NHIS has been used extensively to calculate national estimates for mammography utilization. Studies using the NHIS vary based on the use of different outcome measures (i.e., different years for defining mammography adherence), the sociodemographic characteristics of the study population (i.e., various age ranges), as well as the types of independent variables and covariates included in the study. Nonetheless, the various population-based studies provide valuable information as to the use--or nonuse--of mammography among the general U.S. population and subpopulations. In addition, the NHIS data may indicate the factors and barriers associated with mammography to be discussed in this second section of the literature review.

Population-based studies also provide valuable information for comparing the health objectives promoted by the Healthy People campaign. The Healthy People 2000 objective for 60% of the female population ≥ 50 years to receive mammography within the previous year is considered the de facto goal for most studies. The updated goal for the Healthy People 2010 campaign is biennial mammography for women has been increased to 70% of women ages ≥50 years (U.S. DHHS, 2000). As evident in the different objectives in the Health People 2000 and 2010 campaigns, many studies measure mammography utilization for different periods of time. A majority of studies measure mammography use during the previous year, although some measure biennial mammography (i.e., mammography completed within the previous two years). Summaries of mammography utilization for both outcome measures follow.

Annual Mammography Use

Bernstein, Thompson, and Harlan (1991) used the Cancer Control Supplement of the 1987 NHIS to examine the utilization rates for six screening tests for cancer, including mammography. The study population for mammography use was restricted to women ages 40 and older (n = 4,728) who reported a usual source of medical care. Usual source of medical care was categorized as 'HMOs' (e.g., prepaid group practices group health, or HMO), 'doctor's offices', or 'institutions' (e.g., public health clinics, health centers, etc.). The dependent variable used in this analysis was whether the woman self-reported mammography use within a 3-year period. Mammography utilization rates were 54.7%, 28.1%, and 28.5%, respectively, for women whose usual source of medical care were HMOs, doctor's offices, and institutions. The authors believe the difference in utilization rates between HMO and non-HMO members reflects the incentive of HMOs to focus on prevention-oriented activities (Bernstein, Thompson, & Harlan, 1991).

The same 1987 NHIS Cancer Control Supplement was analyzed by Calle, Flanders, Thun, and Martin (1993) to determine the demographic characteristics predicting the underutilization of mammography and Pap smear screening. The dichotomous dependent variables were never having been screened for mammography and not having been screened in the past year. Although this study examined the nonuse of mammography, it does offer insight into utilization rates. The authors determined that 86% of the female respondents (n = 6,353) had not undergone mammography in the past year. That means the 1987 annual mammography utilization rate for women ages ≥ 40 years was a startlingly low 14%.

Burack, George, and Gurney (2000) used the 1992 NHIS Cancer Control Supplement to evaluate the relationship between age and self-reported patient involvement in decision-making for undergoing mammography. Mammography utilization was based on self-reported mammography during the preceding year for specified age groups. Among the 3,863 respondents ages ≥ 40 years, mammography rates varied by age groups. Women between 50 to 54 years old demonstrated the highest proportion of mammography within the previous year (36%) with a gradual decline to 16% for women ≥ 75 years.

The results reported by Burack, Gurney, and McDaniel (2000) are more encouraging regarding annual mammography. Respondents in the 1992 NHIS and Cancer Control Supplement ≥ 50 years who reported one or more lifetime mammograms were included in this study (n = 1,772). Women without any mammogram in their lifetime (n = 937) were excluded. Among women reporting at least one lifetime mammogram, 60.6% had their most recent mammogram within the previous 12 months. Although the 60% utilization rate is encouraging, it should be viewed with caution as the study population only included those women who had previously undergone mammography at some time in their life. The study may not accurately reflect the true utilization rate among the entire U.S. population.

Biennial Mammography Use

Based on CMS (formerly HCFA) enrollment and claims files, the estimated rate of mammography use for Medicare recipients within the previous two years, by state, ranged from 32.2 to 48.4% during the 1994-1995 period (U.S. DHHS, 1997). Horton,

Cruess, and Romans (1996) report on the proportion of women in the U.S. following ACS mammography recommendations using the 1995 Jacob Institute of Women's Health (JIWH) Mammography Attitudes and Usage Study. The sample population was weighted to provide a nationally representative estimate of the U.S. population. The sample consisted of 1,071 women ≥40 years. The overall utilization rate for the ≥40 year group was 47.4%. However, the proportion reporting adherence with mammography recommendations was highest for the 40 to 49 year age group (51.8%) and declined with age to a low of 40.4% for women ≥ 65 years.

In reviewing the various population-based studies providing estimates of mammography utilization in the U.S., it is apparent that the Healthy People 2000 goal of 60% of the women ≥ 50 years undergoing mammography in the previous year has not been achieved. Furthermore, disparities in mammography use among various subpopulations are evident. The characteristics of various groups and factors that are positively and negatively associated with mammography utilization will now be discussed.

Factors Associated with Mammography Utilization

A considerable amount of research has been conducted to determine the factors positively associated with mammography utilization (predictors) and those with negative associations (barriers). Understanding the factors associated with mammography utilization is important for monitoring health care use by the general population and specific subpopulations. It also aids in the creation and implementation of interventional strategies and programs to increase the use of mammography by targeted populations.

Factors that influence the use of mammography will be summarized using different dimensions of the health services utilization model: environmental influences, population characteristics, health behaviors, and outcomes of health behaviors/health care. Table 9 illustrates some of the vast literature discussed concerning mammography utilization.

Environment

Research on the influence of environmental factors on mammography utilization has included the impact of the external environment as well as characteristics of the health care system available to the individual.

External environment. The influence of geographic factors on the access to and use of health care and preventive services has been investigated. Women residing in rural areas increasingly have fewer health care delivery sites as compared to women in urban areas (Dowling, 1999; Ferris & Litaker, 1993; Liff et al., 1991). In a majority of studies, rural is defined as residence in a nonmetropolitan statistical area (MSA). An MSA is a county or group of adjoining counties containing at least one urbanized area. The population must consist of ≥ 50,000 inhabitants. Rural women also utilize health care and preventive services at lower rates that urban denizens (Bryant & Mah, 1992; Calle, Flanders, Thun, & Martin, 1993).

Specific to mammography, an association between residence in a rural or nonmetropolitan locality and decreased use of mammography has been demonstrated. Only 39.0% of nonmetropolitan women surveyed in the 1995 JIWH Mammography Attitudes and Usage Study adhered to ACS recommendations as compared to 50.5% of

Table 9

Previous Studies--Association of Various Factors with the Use of Mammography

Variable	Author (s)*	Year of Publication	Sample Size (total)	Effect on Mammography Use
Self reported disabilities				
ADL limitations	Chan	1998	15,590	
	Blustein	1998	2,352	decrease
	Ives	1996	2,205	
Mobility limitations	Iezzoni	2000	not provided	decrease
Cognitive limitation	Blustein	1998	2,205	decrease
	Ives	1996		
Work limitations	none			
Environment				
Geographic region	Frazier	1996	22,656	varied
	Burns	1996	3,187,116	
Rural residency	Horton	1996	1,071	decrease

Table 9 (continued)

Variable	Author (s)*	Year of Publication	Sample Size (total)	Effect on Mammography Use
Population Characteristics				
Age (increasing age	Blustein	1998	2,352	
	Breen	1997	68-1,070	
	Persky	1997	242	decrease
	Marwill	1996	482	
	Hedegaard	1996	10,982	
	Halabi	1993	12,952	
Race (minority)	Suarez. . . Simpson	1997	923	
	Bowen	1997	49	
	U.S. DHHS	1997	16,397,730	decrease
	Frazier	1996	22,656	
	Hedegaard	1996	10,982	
	Rojas	1996	442	
Education (increasing levels)	Cummings	2000	843	
	Phillips	1998	2,026	
	Mickey	1997	685	
	Maxwell	1997	5,030	increase
	Frazier	1996	22,656	
	Ives	1996	2,205	
	Miller	1993	161	

Table 9 (continued)

Variable	Author (s)*	Year of Publication	Sample Size (total)	Effect on Mammography Use
Income (higher levels)	Hsia	2000	55,278	
	Blustein	1998	2,352	
	Potosky	1998	2,093	
	Horton	1996	1,071	increase
	Hedegaard	1996	10,982	
	Breen	1994	6,730 & 12, 860	
	Calle	1993	6,353	
Presence of a significant other/spouse	Maxwell	1997	5,030	increase
	Ives	1996	2,205	
Health Insurance (any policy)	Hsia	2000	55,278	
	Lane	2000	5,318	
	Cummings	2000	843	
	Gordon	1998	424	
	Potosky	1998	2,093	increase
	Mickey	1997	685	
	Faulkner	1997	10,643	
	Horton	1996	1,071	
	Breen	1994	6,730 & 12, 860	
	Calle	1993	6,353	

Table 9 (continued)

Variable	Author (s)*	Year of Publication	Sample Size (total)	Effect on Mammography Use
Health Behaviors				
Smoker	Qureshi	2000	18,245	decrease
	Rakowski	1999	5,317-10,845	
Previous CBE	Cummings	2000	843	increase
Usual source of care	Kelaher	2000	2,419 & 1,872	
	Maxwell	1997	5,030	increase
	Martin	1996	3,534 & 6,353	
Volume of health care use (higher volumes)	Cummings	2000	843	
	Rakowski	1998	1,727	
	Maxwell	1997	5,030	increase
	Lantz	1997	2,346	
	Mickey	1997	685	
Health Outcomes				
Obese	Wee	2000	3,397	decrease
	Fontaine	1998	6,981	

Table 9 (continued)

Variable	Author (s)*	Year of Publication	Sample Size (total)	Effect on Mammography Use
Previous breast cancer	Paskett	1998	555	
	Allen	1998	194	increase
	Thomas	1996	1,011	
	Vernon	1993	33,543	
Other comorbid conditions (increased levels)	Hsia	2000	55,278	mixed
	Blustein	1998	2,352	

* For brevity, the 'author' column only lists the first author of multiple author manuscripts. Please consult the bibliography for complete citations.

metropolitan women ($p < .05$) (Horton, Cruess, & Romans, 1996). However, the influence of geography on mammography utilization is not restricted to rural versus urban classification.

Frazier, Jiles, and Mayberry (1996) controlled for geographic region (e.g., South, Northeast, Midwest, and West) in their examination of 22,657 women who participated in the 1990 Behavioral Risk Factor Surveillance state-based telephone survey. They report that African American women residing in the West were two times more likely (95% CI: 1.3, 3.0) to have had a mammography examination in the previous year as compared to women in the South. Hispanic women in the Northeast were 1.7 times more likely (95% CI: 1.0, 3.0) to have had mammography as compared to Hispanic women in the South. Frazier and colleagues, however, do not offer a reason as to why geographic variability in mammography utilization may exist. Similarly, Burns and colleagues (1996) report varying rates for elderly African American and Caucasian women in 10 states, as well. Rates ranged from a high of 21% in Washington to 7% in Oklahoma for Caucasians. African American utilization was lower across all states.

In examining the association of environment and mammography utilization, Wells and Horm (1998) utilized the 1989-1991 National Health Interview Survey combined with the NHIS Health Promotion and Disease Prevention 1990 supplement to test the utility of new ecological variables created by the authors. Ecological variables were calculated using secondary sampling and include the following: percentage of area with black population, percentage of area with Hispanic population, percentage of residents below poverty, percentage unemployed, median education, median income,

median age, and percentage residing in the U.S. for ≤ 5 years. Consistent with previous research, Wells and Horm found that mammography use was negatively associated with level of education and was lower in areas with higher proportions of minority women. Lacking in most studies of mammography is the use of mammography by disabled rural residents.

Health care system. Similar to the association between geographic region and mammography use, certain characteristics of the health care system may promote mammography utilization. Phillips, Kerlikowske, Baker, Chang, and Brown, (1998) combined the 1992 NHIS with both the 1992 National Survey of Mammography Facilities, county-level data, HMO market share, and the supply of primary care providers to examine mammography use. This study is one of the more detailed examinations of mammography utilizing that incorporated the National Health Interview Survey database by including linkage with other data sets. A relevant finding was that the mammography utilization was highest in those regions with higher HMO market share ($p < .05$). This finding may reflect the emphasis on preventive care in managed care organizations.

Environmental conditions of the health care systems can also include programs or features within an individual institution. Health care institutions that use patient or clinical reminder systems demonstrate improvements in utilization (Grady, Lemkau, Lee, & Caddell, 1997; Yarnall et al., 1998). These prompts are important for both physicians and patients since physician recommendation is an influential factor in a woman's use of mammography.

In addition, health care institutions may incorporate a variety of interventions to increase mammography utilization among the overall population and specific subgroups. Facilities that have developed patient-oriented programs aimed at improving mammography utilization addressing the costs of the procedure (Skaer, Robison, Sclar, & Harding, 1996; Scammon, Smith & Beard, 1995; Stoner et al., 1998), programs specifically targeting racial/ethnic groups (Bird et al., 1998; King, Rimer, Seay, Balshem, & Engstrom, 1994; Skinner, Strecher, & Hospers, 1994; Sung et al., 1997) and patient education via various delivery methods (Dalessandri, Cooper, & Rucker, 1998; Hardy et al., 1996; Margolis, Lurie, McGovern, Tyrrell, & Slater, 1998; Turner, Wilson, & Gilbert, 1994) have demonstrated some success in improving mammography rates of their patients.

Population Characteristics

In this section, sociodemographic characteristics, enabling resources, and need will be discussed as they relate to mammography utilization. Included in the section on need is discussion of mammography use by disabled or impaired individuals and the reported association between mammography use and functional limitations.

Sociodemographic Characteristics. As previously discussed in the review of population-based research, many studies have demonstrated variation in rates of mammography use by various age groups. The consistent inverse relationship between age and mammography utilization is particularly relevant since age is a major risk factor for breast cancer. The highest screening utilization rates are found for women in their fifties and decline in women with advanced age (Balducci & Phillips, 1998; Breen, Feuer,

Depuy, & Zapka, 1997; Fox, Roetzheim, & Kingston, 1997; Halabi, Vogel, Bondy, & Vernon, 1993; Marwill, Freund, & Barry, 1996; Persky & Burack, 1997). For example, women ages 50 to 64 years who visited a Denver Community Health Center (n = 10,982) had a relative risk for obtaining a mammogram of 1.57 as compared to women ages 40 to 49 years (95% CI: 1.42, 1.73) (Hedegaard, Davidson, & Wright, 1996). Frequently, women ≥ 65 years of all racial/ethnic groups demonstrate the lowest rates of mammography utilization (Blustein & Weiss, 1998; "Use of Cervical," 1998). In the aforementioned Denver Community Health Center study, the relative risk for women ≥ 80 years for obtaining a mammography was 0.37 (95% CI: 0.28, 0.50) (Hedegaard, Davidson, & Wright, 1996).

Marital status has been found to be significantly related to preventive care use (Collins & LeClere, 1996), including mammography, in some studies. For example, an adjusted odds ratio of 1.97 (95% CI: 1.51-2.57; $p \leq .001$) was reported for single women who never had a mammogram as compared to the married/common-law/partner reference group (Maxwell, Kozak, Desjardins-Denault, & Parboosingh, 1997). Married women demonstrated higher mammography utilization rates than widowed, divorce/separated, and those who were never married ($p = .001$) (Ives, Lave, Traven, Schulz, & Kuller, 1996). Higher rates of mammography use by married women may reflect the influence of the spouse to receive health care.

Level of education appears to be positively associated with health and preventive care use. Grossman (1972 a, b) posits that educated persons are more efficient consumers of health services because they may better understand how to use health care services and

alter their lifestyle to reap greater health rewards. Education is often a statistically significant factor in mammography utilization (Cummings, Whetstone, Shende, & Weismiller, 2000; Ives, Lave, Traven, Schulz, & Kuller, 1996; Maxwell, Kozak, Desjardins-Denault, & Parboosingh, 1997; Mickey, Vezina, Worden, & Warner, 1997; Miller & Champion, 1993; NCI Cancer Screening Consortium for Underserved Women, 1995; Phillips, Kerlikowske, Baker, Chang, & Brown, 1998). Consequently, women with higher levels of education have higher utilization rates as compared to women with less education (Horton, Cruess, & Romans, 1996; Ives, Lave, Traven, Schulz, & Kuller, 1996; Mickey, Vezina, Worden, & Warner, 1997).

For example, Frazier, Jiles, and Mayberry (1996) report that 57.9% of Caucasian women (n = 19,882) with greater than a high school education obtained mammography within the previous year as compared to 35.9% who had less than a high school education. A 20% difference in utilization rates were reported between African American and Hispanic women with varying levels of education attainment, as well. Although the operational definitions of education vary by study, most measure whether the woman is a high school graduate as compared to women with less than a high school education.

Disparities in access to and use of health care services according to racial and ethnic differences have been documented (Mayberry et al., 1999). Much is known regarding the utilization of mammography by various racial and ethnic groups because the majority of studies incorporate this demographic variable into the analysis. Many studies demonstrate that African-American, Hispanic, and Native-American women's

utilization of mammography is lower as compared to Caucasians (Bowen, Hickman, & Powers, 1997; Burns et al., 1996; Frazier, Jiles, & Mayberry, 1996; Hedegaard; Davidson, & Wright, 1996; Hoffman-Goetz & Mills, 1997; NCI Cancer Screening Consortium for Underserved Women, 1995; Rojas et al., 1996; Suarez, Roche, Nichols, & Simpson, 1997; Valdini & Cargill, 1997). For example, approximately 27% of Caucasian women had a Medicare mammogram claim in 1995 as compared to 20% of African-American beneficiaries (U.S. DHHS, 1997). Lower utilization is especially troubling among the African-American population as their cancers are usually more advanced at initial diagnosis (Champion & Menon, 1997; Ries et al., 2000), resulting in higher mortality rates for African-American women (Marbella & Layde, 2001). The late diagnosis of breast cancer for African American women explains approximately 40% of the differences in 5-year survival rates between African Americans and Caucasians (Eley et al., 1994).

Recent research has begun to fill the gap in knowledge regarding the association of Hispanic ethnicity and breast cancer survival. Hedeen and White (2001) used SEER data to analyze the relationship between breast cancer in Hispanic women and early detection. The authors found that breast tumor size was larger in Hispanic than in nonHispanic Caucasians at initial diagnosis. Consequently, rates of mortality from breast cancer for Hispanic women are anticipated to exceed that of Caucasian women. In addition to various sociodemographic characteristics, enabling resource factors (i.e., socioeconomic factors) have been demonstrated to influence the use of mammography.

Enabling resources. Positive associations between income level and mammography utilization have been reported in the literature. Women who are economically disadvantaged demonstrated lower rates of mammography utilization as compared to noneconomically disadvantaged women (Breen & Kessler, 1994; Calle, Flanders, Thun, & Martin, 1993; Hsia et al., 2000; NCI Cancer Screening Consortium for Underserved Women, 1995). For example, 24% of women ≥ 40 years with annual household incomes < $20,000 had a mammogram in the previous year as compared to 39% of women with household incomes > $20,000 (Breen & Kessler, 1994). Calle and colleagues (1993) demonstrate that 80% of rural women who lived below the federal poverty level had never had a lifetime mammogram.

The operational definitions categorizing household income varies between studies; Horton, Cruess, and Romans (1996) categorized annual household income as < $25,000; $25-49,000; and > $50,000. Blustein and Weiss' (1998) examination of Medicare beneficiaries used lower income categories: ≤ $6,300; $6,301-$9,260; $9,261-$15,160; and > $15,160. Potosky and colleagues (1998) used a dichotomous variable for household income with $20,000 as the threshold. A different approach for measuring household income was used by Hedegaard, Davidson, and Wright (1996). The authors used the level of subsidized care (LSC) from the Denver Community Health Services as a proxy for income. LSC was calculated based on adjusted annual income, assets and liabilities, and family size. Notably missing in many studies investigating the association of income and mammography use is the inclusion of disability status as a control

variable. Considering that disability women are disadvantaged, inclusion of this characteristic would indicate if an interaction between income and disability status exists.

Socioeconomic status/income are also related to the presence of health insurance. Unemployed or low income persons are less likely to have health insurance and access to health care (Bashshur, Homan, & Smith, 1994; Koch, 1999; Newacheck, 1988). Mammography utilization is strongly associated with a woman's socioeconomic status and presence of either public or private insurance coverage (Breen & Kessler, 1994; Calle, Flanders, Thun, & Martin, 1993; Cummings, Whetstone, Shende, & Weismiller, 2000; Faulkner & Schauffler, 1997; Gordon, Rundall, & Parker, 1998; Horton, Cruess, & Romans, 1996; Hsia et al., 2000; Lane, Zapka, Breen, Messina, & Fotheringham, 2000; Mickey, Vezina, Worden, & Warner, 1997; Potosky, Breen, Graubard, & Parsons, 1998). In addition, mammography utilization is often higher for those women enrolled in managed care plans (i.e., health maintenance organizations [HMOs], independent practice associations, etc.) (Breen & Kessler, 1994; Gordon, Rundall, & Parker, 1998; Tu, Kemper, & Wong, 2000).

Need. Need as a characteristic of the population refers to the presence/perception of illness, conditions, or disease that serve as predictors of health service utilization as measured through various proxy indicators. Measures of need may be based on patient's perceptions (i.e., perceived need) or on the professional opinion or recommendation of a health care provider (i.e., evaluated need). In the health services literature, the need for mammography has been investigated using proxies based on perceived need. These include women's self-reported health status and functioning indicators, and perceptions

of susceptibility and risk of breast cancer. In addition, physician recommendation has been investigated, representing the evaluated need factor.

Perceived health status has been investigated regarding its association with mammography use. Mammography use in a previous two-year period were examined in female respondents (≥ 75 years) in the 1992 MCBS (Blustein & Weiss, 1998). Women were asked to respond to the question, "In general, compared to other people your age, would you say that your health is excellent, very good, good, fair, or poor?" This question was not related to any particular health care procedures or outcomes. Forty percent of respondents self-reported their health status as excellent or very good; 28.9% reported good; 22.2% fair and 7.6% reported poor health status. Mammography use in the previous two years was found to be significantly related to poor health status, after controlling for age, medical history, and activity of daily living limitations (ADL). Although women with good to fair health status demonstrated lower odds ratios for use of mammography as compared to the reference group (i.e., excellent self-reported health status), the results were not statistically significant ($\alpha = .05$). However, women with poor self-reported health status were more than half as likely to have undergone mammography in the previous two years as compared to women with excellent health status (AOR = 0.41; 95% CI: 0.26, 0.56; $p < .05$).

Similar results are reported by Burack, Gurney, and McDaniel (1998) for a younger age cohort (≥ age 50 years). Among the 1992 NHIS respondents with one or more lifetime mammograms (n = 1,772), the authors found that women with poor self-reported health status had an odds ratio of 0.84 (95% CI: .55, 1.28) for being less likely to

have undergone mammography in the previous year as compared to the reference group (i.e., combined good, very good, and excellent self-reported health statuses). The analysis simultaneously controlled for age and various sociodemographic covariates. However, these results must be viewed with caution, as the estimates were not weighted in accordance with the survey's complex sampling design. The results are only valid for the sample population and not the national population.

Compared to self-reported health status, evaluated health status relies on the judgment of a health care professional based on clinical standards and medical practices. Various methods for measuring health status are found in the literature, including tools such as the Medical Outcomes Study 36-Item Short Form (MOS SF-36), Health Insurance Experiment-Functional Limitations (HIE-FL), the Health Utility Index (HUI), and the Quality of Well-being (QWB) scale. In addition, the measurement of functional status according to the presence or number of activities of daily living (ADLs) and instrumental activities of daily living (IADLs) is common in health care literature.

ADLs include the ability to perform the following six tasks or activities: getting around inside the home, getting in or out of bed/chair, bathing, dressing, eating, and toileting. IADLs are based on one's ability to go outside the home, keep track of money and bills, prepare meals, do light house-work, take prescription medicines in the right amount at the right time, and use the telephone. As is evident from the descriptions of ADLs and IADLs, ADLs represent basic daily functioning or activities. IADLs are higher-order activities predicated upon one's ability to perform ADL activities. ADLs and IADLs are frequently reported in the health literature as either the total number (or

categories) of limitations or as a dichotomous variable representing the presence of one or more limitations.

A health status factor that has received much attention has been the impact of functional status on mammography use. However, the study populations in the examination of functional limitation(s) and mammography have been restricted to Medicare recipients ≥ 65 years. Chan and colleagues (1999) used the 1995 MCBS to compare mammography use by Medicare patients with differing levels of disability. Disability was categorized as the number of self-reported ADL limitations (i.e., 0, 1-2, 3-4, 5-6 ADLs). Compared to a nondisabled control group, the proportion of severely disabled women ≥ 50 years who underwent mammography was significantly lower (13% disabled versus 44% nondisabled; $p < .001$). Severe disability was defined as limitations in 5 or 6 activities of daily living (ADLs). In the controlled analysis, the authors found that women with severe disabilities were 56% less likely to receive mammography as compared to women without severe disabilities regardless of their race, age, or enrollment in a health maintenance organization. A limitation of this study, however, is its restriction to disabled Medicare beneficiaries ≥ 65 years.

Blustein and Weiss (1998) report similar results in their study of women ≥ 75 years. Also using the MCBS, the authors investigated factors associated with health, functioning, and age on mammography utilization. The retrospective cohort design (n = 2,352) demonstrated that mammography use was substantially reduced by advanced age and impaired functional status. However, unlike Chan et al., Blustein and Weiss operationalized ADL as a dichotomous variable. Women who reported any functional

limitations were categorized as having limitations in level of functioning. ADL limitations were independently associated with decreased mammography use (AOR = .41; 95% CI: .27, .64). Because of the dichotomous coding, Blustein and Weiss' study may overrepresent the influence of ADL on mammography utilization. Studies that can use a scale to measure the level of disability can provide results that are more specific.

Functional limitations were also investigated in study of mammography use by rural women (Ives, Lave, Traven, Schulz, & Kuller, 1996). Ives and colleagues used a prospective design to study Medicare Part B enrollees who volunteered to participate in a Medicare demonstration project. The study population consisted of women ≥ 65 years (n = 2,205) who resided in five rural Pennsylvania counties; the outcome measure was mammography use in the previous two years. After controlling for various sociodemographic variables, Ives and colleagues found that women with ≥ 1 ADLs were half as likely to have had mammography examination in the previous two years (AOR = .56; 95% CI: .34, .93; p = .0253) as compared to functionally independent women (0 ADLs). The presence of IADLs was not a statistically significant variable that was associated with mammography use (p = .4646).

Iezonni, McCarthy, Davis, and Siebens (2000) examined the association of mobility impairments on the use of screening and preventive services, including mammography for women ≥ 50 years. Mobility limitations were classified as "none," "minor," "moderate," or "major," based on self-reported difficulties in "walking a quarter of a mile-about 3 city blocks," "walking up 10 steps without resting," and/or "standing for about 20 minutes"). Other study variables included demographic and medical care

use. Women who reported "major" mobility difficulties (i.e., inability to walk a quarter of a mile, 10 steps without resting, or stand for 20 minutes) were 30% less likely to undergo mammography in the previous 2 years as compared to women without mobility limitations (AOR = .70; 95% CI: .05, .09; p = .01). No other forms of disability were examined in this study, however. The author's included only mobility impairment and did not include impairments that affect daily living or cognition. Therefore, Iezonni and colleagues study provides an incomplete evaluation of disability and mammography use.

Last, Nosek and Howland (1997) used a case-comparison approach to study disabled women (n = 210) and their "able-bodied friends" (n = 110), ages 40 to 65 years. In this study, the most frequent primary causes of physical disability included spinal cord injuries, polio, neuromuscular disorders, and cerebral palsy. Mammography use within the previous two years was assessed via self-reports. The authors found no significant differences in the proportion of disabled women (55.2%) as compared to nondisabled women (50%) who had a mammogram in the previous two years. However, these results cannot be generalized beyond the study population due to sampling method used.

The influence of cognitive limitations and associated conditions on mammography use has received limited attention, although cognitive limitations and impairments are associated with aging (Campbell, Crews, Moriarty, Zack, & Blackman, 1999). The operational definitions of cognitive status and/or limitations vary in the health care literature, including: self-reported confusion (Grams & Cutler, 1992), cognitive status (i.e., self-rating of memory, orientation to place and time, assessment of recall and working memory) (Zsembik, Peek, & Peek, 2000), or the presence of dementia

(Gillick & Mendes, 1996). Because cognitive impairment is increasingly recognized as a source of limitation in older adults, questions assessing cognitive status were added to the NHIS in 1997 (NCHS, 2000).

Zsembik, Peek, and Peek (2000) found racial and ethnic differences in cognitive limitations of a representative sample of persons ≥ 70 years. They report that the racial and ethnic minorities demonstrate significantly higher rates of limitations as compared to Caucasians ($p < .05$). For example, the proportion of African-Americans with cognitive limitations was 73%. Mexican-American's cognitive limitation rate was 68.5% compared to 30.4% for Caucasians.

Ives and colleagues' (1996) study of rural Medicare beneficiaries (1996) incorporated dementia as a covariate for mammography use. Cognitive status was evaluated using the Mini-Mental State Exam (MMSE) to test for cognitive impairment (i.e., dementia). Possible cognitive impairment was defined as those women with MMSE scores ≤23 (out of a maximum of 30). A greater proportion of women (45.3%) classified as noncognitively impaired underwent mammography as compared to potentially cognitively impaired women (32.0%; $p = .008$). However, after controlling for various sociodemographic and functional variables, cognitive status was not a statistically significant influence on mammography use (AOR = .98; $p = .9412$).

The association of Alzheimer's disease on mammography utilization during the previous two years was examined by Blustein and Weiss' (1998) retrospective cohort study of women ages ≥ 75 years (n = 2,352). Respondents in the MCBS were asked if a doctor ever told them that they had Alzheimer's disease, dementia, or a mental or

psychiatric disorder. Age adjusted logistic results indicate that women with Alzheimer's disease were significantly less likely to use mammography in the previous two years (AOR = 0.55; $p < .05$). Although these results indicate an association between mammography utilization and a cognitive limitation, dementia, the population was restricted to an older population (i.e., ≥ 75 years).

In Great Britain, Davies and Duff (2001) surveyed women age ≥50 years with intellectual disability living in community group homes. Respondents or proxies (n = 58) were questioned regarding their utilization of mammography. Unfortunately, no time period for the utilization of mammography was given. Among women with intellectual disabilities, only 46% reported undergoing a mammogram. The authors conclude that women with intellectual disabilities may be at-risk for underutilization of mammography due to a personal lack of knowledge of breast cancer as well as limited promotion from physicians or nursing staff.

Regarding perceived need for mammography, women's perceived risk or susceptibility is an important predictor of utilization (Coughlin, 1998; Mahmoodian, 1997; Maxwell, Bastani, & Warda, 1998; Montaño, Thompson, Taylor, & Mahloch, 1997) In addition, fear of breast cancer or mammography (Hoffman-Goetz & Mills, 1997; Rojas et al., 1996; Valdini & Cargill, 1997; Vernon et al., 1992) and knowledge of the benefits of mammography (Dolan, Lee, & McDermott, 1997; Lobell, Bay, Kelton, Rhoads, & Keske, 1998; Paskett et al., 1998; Skinner, Arfken, & Sykes, 1998; Suarez, Roche, Nichols, & Simpson, 1997) are associated with increased mammography utilization.

Among health care provider factors that influence women's use of mammography services, an important and consistent predictor is physician recommendation. Women are more likely to undergo mammography if their physician has recommended the examination (Frazier, Jiles, & Mayberry, 1996; Johnson & Meischke, 1994; Lane, Caplan, & Grimson, 1996; Saver, Taylor, Treadwell, & Cole, 1997). Unfortunately, Vernon and colleagues (1992) report that one-third of African American women in their study cited lack of physician recommendation as the reason for not having mammography in the past.

However, research reveals that mammography recommendations by physicians are not always consistent. Recommendations for mammography may vary by the physician's specialty (Ackermann & Cheal, 1994; Roetzheim, Fox, & Leake, 1995), race/nationality (Ackerman & Cheal, 1994), gender (Ackermann & Cheal, 1994; Andersen & Urban, 1997; Nutting et al., 2001; Saver, Taylor, Treadwell, & Cole, 1997), and knowledge of breast cancer risk factors (Lane & Messina, 1999).

In addition to characteristics of the physician, recommendation for mammography may vary on the patient's characteristics, including age, race, and socioeconomic status (Roetzheim, Fox, & Leake, 1995; Solberg, Brekke, & Kottke, 1997; Vernon et al., 1992), age, and cognitive status (Marwill, Freund, & Barry, 1996). In their cross-sectional survey using clinical case vignettes, Marwill and colleagues found that physicians ($n = 482$) were less likely to recommend mammography to women with mild dementia as compared to those women without dementia ($p < .05$). Similarly, a physician's recommendation for mammography may also depend upon the specifics of the health

care visit. Nutting and colleagues (2001) report that physician's recommendations for mammography may be less likely if the patient has more urgent medical issues that would supercede typical preventive care.

Health Behavior

Health behaviors represent an individual's personal health practices as the use of formal health care services (Andersen & Davidson, 1999). Barriers to health care access, such as cost or transportation, can also affect health behaviors and health practices. Personal health practices, use of health care services, and barriers to access for health care will now be discussed as they relate to the use of mammography by women ≥ 50 years.

Personal health practices. Personal health practices and lifestyle can significantly affect health and well being (Fuchs, 1974). Examples of health practices include diet and nutrition, exercise, smoking and alcohol consumption, self-care, and adherence to medical recommendations/regimens (Andersen & Davidson, 1999; Fuchs, 1974). The literature indicates that women who engage in healthy behaviors are more likely to use preventive health services, such as Pap tests, clinical breast examinations, and mammography (Hofer & Katz, 1996; Maxwell, Kozak, Desjardins-Denault, & Parboosingh, 1997). Women's use of Pap tests and/or clinical breast examination have been found to be predictive of mammography use (Phillips, Kerlikowske, Baker, Chang, & Brown, 1998). Qureshi, Thacker, Litaker, and Kippes (2000) examined mammography use in the previous two years for a 40 to 49 year cohort (n = 18,245). Women who engaged in preventive health measures such as Pap test screening were

significantly more likely (OR = 8.99; 95% CI: 7.6, 10.7) to have undergone mammography, after controlling for other factors. Most studies, however, focus on younger age groups and often do not include older women (i.e., ≥ 75 years) in their study populations.

These findings are supported by Cummings and colleagues' (2000) study of 843 rural women. After controlling for various demographic and health care access and utilization variables, the authors found the women who had a Pap smear were 2.56 times more likely (95% CI: 1.50, 4.37) to have had a mammogram in the previous year ($p < .001$). In addition, women who had a clinical breast examination were significantly more likely to have undergone mammography (AOR = 10.22; 95% CI: 6.04, 17.28; $p < .001$).

An association between smoking and a healthy lifestyle/use of preventive care has also been demonstrated in the literature. Qureshi and colleagues (2000) found an inverse relationship between a woman's smoking status and utilization of mammography. Women who were current smokers, according to self-reports, were 24% less likely (AOR = .71; 95% CI: .6, .8) to have obtained mammography in the previous two years. A similar association is reported by Rakowski, Clark, and Ehrich (1999) in their examination of five years of NHIS data (1990-1994); women who smoked one or more pack(s) of cigarettes per day were less likely to have undergone mammography in the previous two years as compared to women who never smoked. This finding was consistent in all five years (AORs .56-.66). The studies by Qureshi and colleagues and Rakowski, Clark, and Ehrich include many control variables in the analysis. Due to the

broad number of variables included in the analysis, the importance of smoking status as a study variable is better established.

Use of health services. An individual's use of health services is often considered indicative of their ability and willingness to access health care. In addition, previous or current medical conditions may influence the volume of health service use. Although the operational definitions of the use of health care services has varied among studies, a consistent finding is that numbers of visits to a medical provider is positively associated with mammography utilization. Maxwell, Kozak, Deshardins-Deanult, and Parboosingh (1997) found that women who had no consultations with a medical doctor in the past year were nearly two times less likely to have ever received a mammogram as compared to the reference group (i.e., 1-3 visits in the past year) (AOR = 1.85; 95% CI: 1.48, 2.32; p = .0001). Results from a biracial sample of 843 rural women $\geq$ 50 years are similar. After controlling for various demographic variables, women who had one or more office visits in the previous year were 2.28 times more likely to have undergone mammography in the previous year as compared to women with no office visits (95% CI: 1.62, 3.21; $p < .001$) (Cummings, Whetstone, Shende, & Weismiller, 2000). Similar associations between mammography utilization and the number of health care/provider visits are reported by Rakowski and Clark (1998), Lantz, Weigers, and House (1997), and Mickey, Vezina, Worden, and Warner (1997).

A usual source of care is often defined as the patient's self-reported access to a consistent or usual health care provider or facility and indicate potentially the influence of a health care provider (Kelaher & Stellman, 2000). A usual source of care may be

related to enabling factors (e.g., presence of health insurance, household income). Nonetheless, usual source of care may serve as a proxy for an individual's access to a health care provider or facility. Data from the 1992 NHIS indicates that having a source of health care is associated with mammography utilization. Women with no self-reported usual source of care were less likely to have had a mammogram in the previous year (Martin, Calle, Wingo, & Heath, 1996). Having a regular medical doctor was found a significant factor influencing a women's never having had a mammogram in Maxwell and colleagues' (1997) analysis of 5,030 Canadian women ages ≥ 40 years. The authors found that women without a regular doctor were 1.56 times less likely to report having had a mammogram (AOR = 1.18, 2.06; $p = .01$).

Kelaher and Stellman (2000) also used the 1990 and 1993 NHIS to investigate the influence of extended financial coverage (i.e., coverage of biennial mammography among Medicare part B beneficiaries) upon Medicare-eligible women. After controlling for a variety of socioeconomic and demographic factors, the authors found that women with a usual source of care were three times more likely to report having a mammogram in the previous two years than those without a usual source of care (AOR = 3.2; 95% CI: 2.4, 4.1; $p < .05$). In addition, Kelaher and Stellman (2000) report that having health insurance other than Medicare was the sole predictor for whether Medicare-eligible women($n = 2,476$) reported a usual source of care. The authors posit that a usual source of care may reflect the influence of a physician or other health care provider upon a woman's care-seeking behavior.

An implicit assumption regarding a usual source of health care is that the patient may develop a trusting relationship with the health care provider, including the patient's increased involvement and role in medical decision making. A role in decision making regarding mammography has been demonstrated to be a predictor of mammography use (Burack, George, & Gurney, 2000). Mickey and colleagues (1997) report that women who discussed mammography with their physician were more likely to have undergone mammography in the previous year as compared to women who did not discuss the examination with their physician (AOR = 1.63; 95% CI: 1.04, 2.56).

Health Outcomes

The health outcomes dimension represents the health status of the individual (perceived and actual medical conditions) and satisfaction with health care that has been received. The ample research on the use of mammography by women with varying health statuses, however, was previously discussed under the "Need" section of the Population Characteristics dimension. Nonetheless, other factors related to health care outcomes include the presence of various medical conditions, and, can result from or influence the use of health care. Studies focusing on mammography utilization in the presence of various medical conditions are discussed. In addition, women's satisfaction with their mammography experience and its potential to influence additional utilization follows.

Medical conditions. The presence of medical conditions can influence the utilization of health services. Certain comorbidities or concurrent medical conditions may influence the utilization of health care. In this section, the impact of diagnosed

cancer, various comorbidities, and obesity will be discussed as they relate to the utilization of mammography.

A family history of breast cancer, a major risk factor for breast cancer, has been demonstrated to influence mammography use. Women with a family or personal history of cancer, especially breast cancer, are more likely to undergo cancer detection examinations such as mammography (Allen, Sorenson, Stoddard, Colditz, & Peterson, 1998; Paskett et al., 1998; Thomas, Fox, Leake, & Roetzheim, 1996; Vernon, Vogel, Halabi, & Bondy, 1993). However, Andersen and Urban's (1998) examination of mammography use by breast cancer survivors is startling. Rural Washington state women ages 50 to 80 years who were breast cancer survivors comprised the study population (n = 248). Among the breast cancer survivors, nearly 30% reported not obtaining mammography in the previous year. Women having a double mastectomy were excluded from the sample. This finding is particularly compelling considering that the breast cancer survivors were at high risk for new primary breast cancers. Fortunately, the majority of the literature indicates that history of cancer may be indicative of mammography use, contrary to the findings of Andersen and Urban.

Various health problems are associated with the aging process; therefore, comorbidities may be more prevalent in the population recommended for breast cancer screening as well as those women diagnosed with breast cancer. Although the data and findings to be discussed focus on patients with diagnosed breast cancer, they provide a foundation for the importance of analyzing comorbid conditions for the age groups of women within mammography recommendation. Data from the NCI SEER Program

reveals that hypertension, heart conditions, and arthritis are more common conditions found in cancer patients (Yancik et al., 1996). Other conditions present at the time of breast cancer diagnosis include chronic obstructive pulmonary disease and diabetes.

The presence of comorbid conditions in breast cancer patients is important because they may affect treatment recommendations, health outcomes, and utilization of mammography. Comorbidity status was found to be a significant and independent factor influencing breast cancer treatment. The presence of comorbidities has an adverse effect on breast cancer survival. West and colleagues (1996) followed 1,196 breast cancer patients to determine their 10-year survival. Women with higher numbers of comorbid conditions were at increased risk of mortality due to breast cancer; comorbidity effects were independent of other factors. Recent findings by Yancik et al. (2001) confirm these results. Conditions such as diabetes, renal failures, stroke, liver disease, and smoking were significant predictors of early mortality in women ≥ 55 years with breast cancer.

Comorbid conditions have also been found to influence mammography use. Blustein and Weiss (1998) found that the presence of myocardial infarction, hip fracture, and Alzheimer's disease/mental disorder significantly reduced women's use of mammography, after controlling for age (≥ 75 years), health status, and functional status. Women with these conditions were nearly half as likely to have undergone mammography in a two-year period as compared to women without these conditions.

Hsia et al.'s (2000) examination of women's' use of mammography in the previous two years demonstrates mixed results regarding the influence of comorbidities on mammography utilization. Among women ages 50 to 64 years (n = 31,684), women

with 'hyperlipidemia requiring pills' were more likely to have undergone mammography in the previous two years (AOR = 1.35; 95% CI: 1.18, 1.54; $p < .0001$). However, diabetes and a prior cardiovascular event decreased the likelihood of having undergone mammography. In the 65 to 79 year cohort (n = 23,594), 'hyperlipidemia requiring pills' and a family history of myocardial infarction was associated with mammography use in the previous two years. Conditions such as hypertension and a prior cardiovascular event were negatively associated with mammography use. The literature examining comorbid conditions and mammography use are fairly consistent in the types of medical conditions defined as comorbid.

Increased body mass index (BMI), a physical measure of obesity, is associated with decreased use of preventive services (e.g., clinical breast, gynecological, and Papanicolaou [Pap] smear examinations). Overweight and obese women were significantly less likely to have undergone mammography as nonobese and nonoverweight women, even after controlling for barriers to care (Wee, McCarthy, Davis, & Phillips, 2000). However, the relationship between obesity and mammography utilization is not well established. This finding is not consistent with Fontaine and colleagues' (1998) study in which BMI was not significantly related to women's delay in obtaining mammography during the previous three years. Nonetheless, obesity may be considered a potential influence upon a woman's likelihood for undergoing mammography.

Satisfaction. An individual's satisfaction with health care may be based on a variety of factors including satisfaction with the physician/health care staff and

perceptions of the care received. Various authors report associations between different dimensions of patient satisfaction and mammography utilization. For example, Glasgow, Whitlock, Valandis, and Vogt (2000) surveyed women (n = 1,574) via questionnaire or telephone interview regarding their self-reported barriers to cancer screening. Factor analysis of survey results demonstrated that embarrassment and mistrust were important barriers to mammography. A 'bad experience' with the test (i.e., mammogram) strongly loaded on this dimension (factor loading = .65). 'Uncomfortable feelings' regarding the examination was also found to be a strong barrier to mammography.

Embarrassment in undergoing a mammogram was also predictive of noncompliance in a study of low-income African American women (n = 574) (Crump, Mayberry, Taylor, Barefield, & Thomas, 2000). Women who believed mammography was an embarrassing experience were nearly three times less likely to have a mammogram (AOR = 2.8; 95% CI: 1.2, 6.4). Based on these studies involving women's satisfaction with mammography care, it appears that positive experiences and satisfaction with the examination are important factors for use of mammography. It should be noted that satisfaction with mammography experience might potentially be influenced by the physical discomfort common in many mammographic examinations. Many studies do not often discriminate between dissatisfaction and discomfort. Consequently, dissatisfaction with mammography may be due to an unfortunate factor inherent in the examination.

Equitable Access and Mammography

As evident from the literature review, a variety of factors--both internal and external to the individual--influence the use of mammography. A concern exists, however, regarding the equitable utilization of mammography by U.S. women. The definition of equitable access to health care is based on the factors or characteristics that predict an individual's realized access (Andersen & Davidson, 1999). Equitable access is the allocation of services based on need (Aday, Begley, Lairson, & Slater, 1998; Andersen & Davidson, 1999). Equitable access to mammography has been frequently investigated because many demographic and enabling resource factors influence mammography use, as previously discussed.

In recognition of inequities in mammography utilization, various interventions have been attempted including: reminder systems for patients and health care providers (Grady, Lemkau, Lee, & Caddell, 1997; Hillman et al., 1998; Yarnall et al., 1998), mobile mammography vans (Levin et al., 1997; U.S. DHHS, 1997), vouchers and low-cost screening (Scammon, Smith, & Beard, 1995; Skaer, Robison, Sclar, & Harding, 1996; Stoner et al., 1998), the use of lay persons as health care advocates (Margolis et al., 1998; Sung et al., 1997), and various forms of media targeting specific populations (e.g., pamphlets, brochures, commercials) (Banks et al., 1995; Fox, Stein, Gonzalez, Farrenkopf, & Dellinger, 1998; King, Rimer, Seay, Balshem, & Engstrom, 1994; Skinner, Strecher, & Hospers, 1994; Suarez, Roche, Nichols, & Simpson, 1997). Unfortunately, mammography interventions directed towards disabled populations are few.

Limitations of Previous Research Evaluating Equity

Despite the concern for inequitable access to mammography services by race or enabling factors, a subpopulation that has received limited attention regarding their access and utilization of mammography is the disabled (Nosek & Howland, 1997; Thierry, 2000). As previously addressed in the literature review, the presence of functional limitations is associated with decreased mammography use. However, the age groups analyzed by various authors (i.e., ≥65 years) and the nonrepresentative nature of the sample populations limit the majority of studies incorporating functional limitation measures as a predictor for mammography use.

In addition, most studies have not incorporated variables that represent the broad definitions of disability currently in use. Previous studies of mammography use among disabled women have only incorporated particular activity limitations (e.g., ADLs, IADLs) without investigating additional factors that may classify one as disabled (i.e., cognitive status and work limitations). Thus, further study is warranted.

Although various environmental, population characteristics, health behaviors, and health outcomes have been investigated regarding mammography use by disabled women, no single study has incorporated all of the factors using a conceptual model such as the health services utilization model. Therefore, it is difficult to account for the variety of confounding factors, influences, and interaction of variables. In addition, the impact of cognitive limitations (i.e., difficulty remembering, confusion) on mammography use have received little attention. In recognition of the limitations or scope of previous

research, this study differs from other studies of mammography use by disabled women by one or more of the following characteristics:

- incorporation of a conceptual framework to examine the multiple factors and dimensions that influence health care utilization,
- utilization of a nationally-representative sample of women,
- examination of mammography use by a wider age cohort,
- defines disability more broadly by incorporating a broader range of disabling limitations and conditions as identified by various governmental sources.

Hypotheses

Using the health services utilization model as a guide, hypotheses will be tested that address the environmental, personal (i.e., population characteristics), health behavior, and health outcome factors that may influence mammography utilization by disabled and nondisabled women ≥ 50 years.

Environmental Hypotheses

Environmental factors, such as geographic locale and residence in a nonMSA, have been demonstrated to have mixed effects on the utilization of mammography among certain populations of U.S. women. As discussed previously in the literature review, Horton and colleagues (1996) found that smaller proportions of rural women adhered to ACS recommendations as compared to metropolitan women. Frazier, Jiles, and Mayberry (1996) cite variations in mammography utilization by geographic region, especially among African-American women. (Frazier, Jiles, and Mayberry, 1996; Horton, Cruess, & Romans, 1996; Wells & Horm, 1998). Moreover, disabled and functionally

limited persons are more likely to live in rural areas (i.e., nonMSAs) and particular regions of the U.S. (LaPlante, Rice, & Kraus, 1991; Rosenbach, 1995). Therefore, based on the research findings that mammography utilization often varies among nonMSA versus MSA-designated urban locales and by regions of the U.S., the following three hypotheses will assess the influence of the environment factors (i.e., rural residency and geographic region) on the use of mammography by disabled women:

H1A. No statistically significant differences exist in mammography rates for disabled women (i.e., presence of any ADL, IADL, cognitive, and/or work limitation [s]) residing in nonMSA locales compared to nondisabled women residing in nonMSA locales.

H1B. No statistically significant differences exist in mammography rates for disabled women residing in MSA-designated locales compared to nondisabled women residing in MSA-designated locales.

H1C. No statistically significant differences exist in mammography rates for women with disabilities (i.e., presence of any ADL, IADL, cognitive, and/or work limitation [s]) and nondisabled women across regions of the U.S.

Population Characteristics Hypotheses

As demonstrated previously in the chapter, sociodemographic characteristics of a population influence the use of mammography. Considering the disparities in mammography use among various racial/ethnic groups, the following hypotheses are used to test the assumption that mammography utilization varies by race/ethnicity among disabled and nondisabled women:

H2A. No statistically significant differences exist in mammography rates for nondisabled (i.e., presence of any ADL, IADL, cognitive, and/or work limitation [s])Caucasian women as compared to nondisabled minority women.

H2B. No statistically significant differences exist in mammography rates for disabled Caucasian women as compared to disabled minority women.

Functional limitations are a characteristic of the population that may influence mammography use (Blustein & Weiss, 1998; Chan et al., 1999; Iezonni, McCarthy, Davis, & Siebens, 2000; Ives, Lave, Traven, Schulz, & Kuller, 1996). However, a factor potentially associated with mammography utilization is cognitive limitations (Ives, Lave, Traven, Schulz, & Kuller, 1996). Unfortunately, cognitive limitations have received little attention. To investigate the influence of cognitive limitations on the use of mammography, the following hypothesis is tested:

H2C. No statistically significant differences exist in mammography rates for women with and without cognitive limitations.

Considering the influence of socioeconomic status on mammography utilization, it is important to determine if mammography rates differ by income. Disabled women are among the most disadvantaged groups in the U.S. (Welner, 1998). Furthermore, disabled women may not necessarily have health care coverage, such as Medicare. Therefore, hypotheses 2E and 2F address the influence of income and 2G investigates the association between the type of health insurance and mammography utilization among disabled women as compared to their nondisabled counterparts:

H2D. No statistically significant differences exists in mammography rates among lower-income (i.e., < $20,000 annual household income) disabled women compared to low-income nondisabled women,

and

H2E. No statistically significant differences exists in mammography rates among higher income (i.e., > $20,000 annual household income) disabled women compared to higher income nondisabled women,

and

H2F. No statistically significant differences exist in mammography rates among disabled and nondisabled women according to type of health insurance.

Health Behaviors Hypotheses

Health behaviors (i.e., use of CBE, Pap tests) have been positively associated with the utilization of mammography as discussed in the chapter (see "Factors Associated with Mammography-Health Behavior"). Women who engage in preventive health practices are more likely to undergo mammography. However, lacking is information regarding the influence among disabled women. The following hypotheses are posed to test the association of selected preventive health behaviors on the use of mammography among disabled and nondisabled women:

H3A. No statistically significant differences exist in mammography utilization rates among disabled and nondisabled women according to smoking status,

and

H3B. No statistically significant differences exist in mammography utilization rates among disabled and nondisabled women according to CBE utilization in the previous year.

Health Outcomes Hypotheses

The outcomes of health behavior and health care were demonstrated previously in the chapter to influence mammography use among U.S. women. Hypotheses 4A and 4B are used to test the association between obesity and the presence/level of comorbid conditions among disabled and nondisabled women:

H4A. No statistically significant differences exist in mammography rates among obese disabled women as compared to obese nondisabled women,

and

H4B. No statistically significant differences exist in mammography rates among nonobese disabled women as compared to nonobese, nondisabled women,

and

H4C. No statistically significant differences exist in mammography rates among disabled and nondisabled women by level of comorbid conditions (i.e., hypertension, coronary artery disease, myocardial infarction, or stroke).

Disability Hypothesis

As indicated in the literature review, various factors influence a woman's use of mammography. In recognition, the disability hypothesis (H5) explores the simultaneous impact of the various factors and characteristics, such as the environment, population factors, health behaviors, and health outcomes on the utilization of mammography.

Disabilities tested include ADL, IADL, work, and cognitive limitations. Hypothesis 5 allows for a more refined analysis among the disabled and nondisabled to determine the extent other factors may mediate the use of mammography:

H5. Mammography utilization is not influenced by the presence of a disability, after controlling for environmental, population characteristics, health behaviors, and health outcomes.

Summary of the Literature Review

Breast cancer represents a serious health threat to U.S. women. The determination of risk factors and the promotion of early detection methods such as mammography have aided in reducing breast cancer mortality. However, despite the efficacy of mammography, studies reveal that mammography is an underutilized procedure among the total U.S. population and among particular subgroups.

Research has focused on the various factors that influence women's use of mammography. Multiple personal, environmental, health behavior, and health outcomes factors are interrelated and can potentially influence a woman's use of mammography. Examples of consistent predictors for mammography underutilization include: membership in a minority racial/ethnic group, lower household income, low educational attainment, lack of physician recommendation. In recognition of the myriad factors and characteristics associated with mammography use, previous research has focused on various interventions that attempt to increase mammography use among the subgroups that underutilized mammography. Nonetheless, knowledge of the factors influencing mammography utilization is lacking for a sizable subpopulation in the U.S.--the disabled.

Disability is complex, encompassing a variety of physical or mental conditions that limit one's societal activities. Although estimates of disability and its various manifestations vary in the U.S. population, this condition becomes increasingly more important with the aging of the U.S. population. Various studies demonstrate that disabled persons--especially women-- are disadvantaged, have lower household incomes and increased medical expenditures. Strong associations between disability and race/ethnicity are also found. The demographic and enabling characteristics of disabled women include the same factors for those women who underutilize mammography.

Should these demographic and enabling factors influence mammography utilization, it would provide evidence that equitable access to mammography does not exist. Unfortunately, our knowledge of mammography use by disabled women has been restricted to particular groups (i.e., Medicare beneficiaries ≥65 years or nonrepresentative samples of women). This study examines the many factors that affect mammography utilization by disabled women ≥ 50 years as compared to their nondisabled cohort.

Figure 4 illustrates the conceptual framework for examining mammography utilization used in this study. As in the original health services utilization model, health care use is assumed to be influenced by multiple factors (i.e., environment, population characteristics, health behaviors, and health outcomes). Specifically in this study, mammography utilization is theorized to be affected directly by factors such as population characteristics, health behaviors, and health outcomes. The environment, as in the original health services utilization model, is theorized to indirectly influence mammography use since population characteristics as well as the outcomes of health

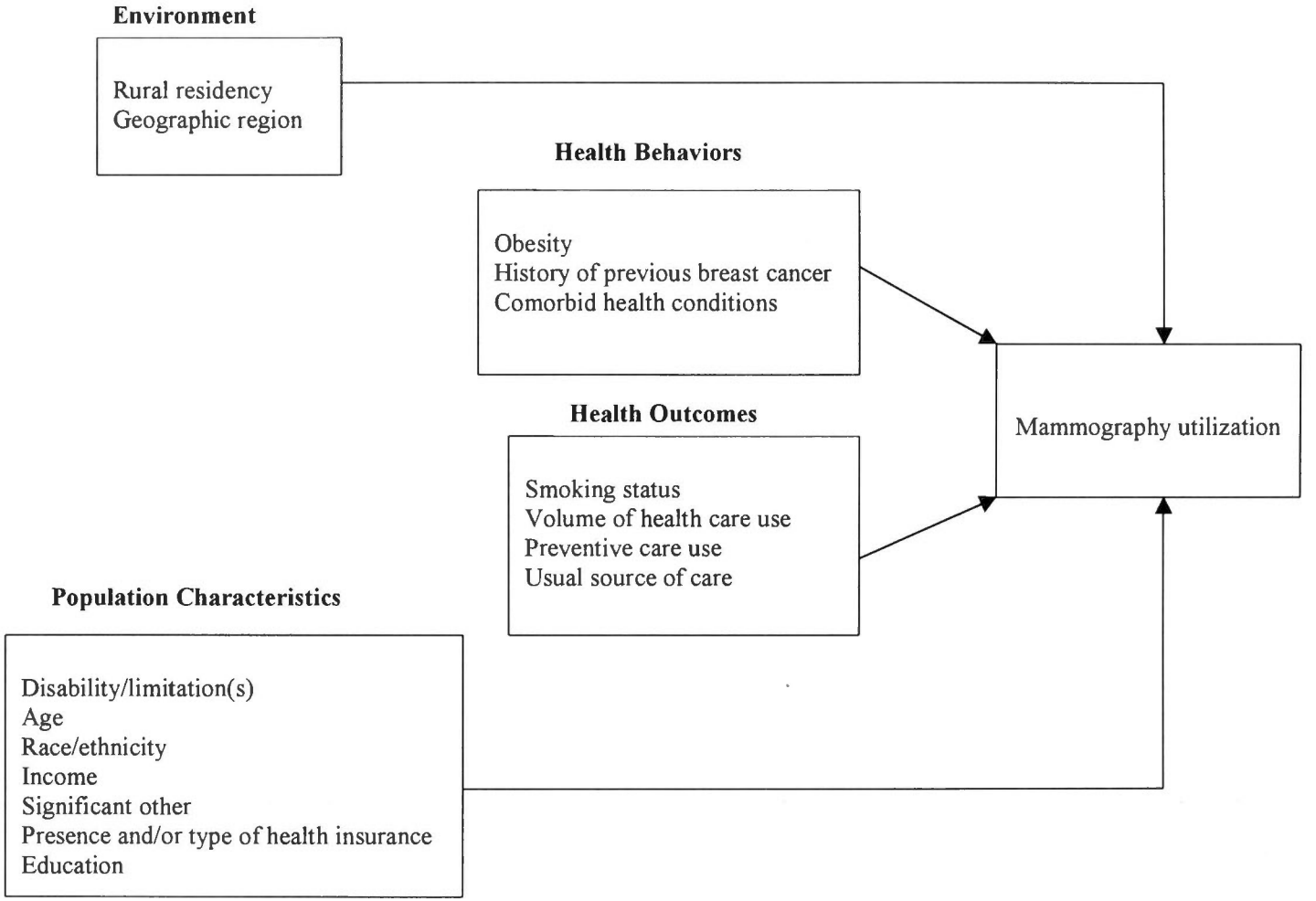

Figure 4. Conceptual framework examining the influences upon mammography utilization.

services mediate environmental factors. However, this study does not evaluate the interrelation between environmental, population characteristics, and health outcomes. Instead, it assumes that all four constructs influence mammography utilization equally.

Using a conceptual framework allows for the determination of some of the factors might influence one's use of mammography. Therefore, the study can reveal if equitable access to mammography exists for the disabled female population, so they, too, may benefit from the potential mortality reductions due to early detection of breast cancer. The next chapter, entitled Methods, specifies how the hypotheses are tested. The data sources, study variables, and analytic strategy are discussed to evaluate if equitable utilization of mammography by disabled women exists.

CHAPTER 3: METHODS

This chapter discusses the research methodology employed in examining the factors influencing mammography use among disabled women in the U.S. First, the data sources and sample selection are described. Discussion of the research design, study variables, and the analytic approach are followed by the delineation of the study limitations.

Data Sources

The source of data for this study is the 1998 National Health Interview Survey (NHIS). The NHIS is a nationally representative, cross-sectional household interview survey conducted by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention. This data set allows for the monitoring of the health of the U.S. noninstitutionalized, civilian population. According to the NCHS (2000), a benefit of the NHIS is its ability to display selected health characteristics by many demographic and socioeconomic characteristics via provision of national estimates of the health status and health care utilization. The NHIS has been conducted since 1957 (NCHS, 2000).

The NHIS consists of three parts: basic, periodic, and topical modules. The basic module remains unchanged during each administration of the survey to allow for trend analysis. The basic module consists of family, sample adult, and sample child core

sections. Examples of information collected include household composition, sociodemographic characteristics, utilization of health services, basic indicators of health status, and tracking information (i.e., identification codes) for linkages to administrative databases (NCHS, 2000). The purpose of the periodic module is to collect information that is more detailed on some of the topics included in the basic module (e.g., cancer-related information).

The topical modules allow for determination of new or specific public health data as the need arises. In addition, the modules may be used to expand upon information on a subject covered in the basic or periodic modules (NCHS, 2000). In the 1998 NHIS, the topical modules contain questions regarding health behaviors of adults and children (e.g., adult prevention, child prevention, pregnancy and smoking modules).

Trained interviewers from the U.S. Bureau of the Census collect NHIS data via in-person interviews. In the 1998 NHIS, approximately 38,000 households were interviewed, with 98,785 persons residing in these households. All adult members of the household (i.e., $\geq$17 years) present at the time of the interview were invited to participate. Proxy responses were accepted for children and adults not present during the interview. Participation in the NHIS was voluntary and confidential. The total household response rate was approximately 90% for the eligible households in the 1998 sample (NCHS, 2000)

The NHIS is a cross-sectional survey using a multistage probability sampling design. This format produces a nationally representative sample of the U.S. noninstitutionalized civilian population (NCHS, 2000; NCHS, 1998). The first stage

consists of the sampling of 358 primary sampling units (PSUs) from the approximately 1,900 geographically defined PSUs in the U.S. The 1,900 PSUs comprise the 50 states and the District of Columbia. A PSU is defined as a county, small group of contiguous counties, or a metropolitan statistical area (MSA) (NCHS, 1998).

The second stage of sampling consists of the establishment and random selection of geographic sampling units (segments) within an individual PSU. All occupied households are targeted for interview within each segment. The households selected for interview are a probability sample representative of the target population (NCHS, 1998). The NHIS sample is chosen so that each person has a known non-zero probability of being selected (NCHS, 2000). Sample weights for individual respondents in the NHIS are provided with the various NHIS data files based on the individual's probability of selection. In addition, adjustments for nonresponse and post-stratification also factor into the development of individual weights (NCHS, 2000). Because of the multistage probability sampling, it is necessary to use the weighting factor for the individual to analyze properly the person-level data. Analysis of data using weighting factors allows for extrapolation of results from the sample population to a larger, national level sample. For confidentiality purposes, all identifying information is removed from the data files by the NCHS before release to the public.

Sample Description and Selection

The 1998 NHIS represents the most recent, complete year of NHIS data publicly available at the time the analysis began. The specific files used in this study are the sample adult (SAMADULT), preventive care-adults (PREVADLT), and the personal

data files (PERSONSX). Person-level data from the three files were linked using the household number (HHX), family number (FMX), and person number (PX) identifiers, as recommended by the NCHS (2000). The PREVADLT file, which comprises the main data file used in this study, consists of an interviewed sample of 32,440 persons ≥ 18 years.

The study sample consisted of all female respondents in the 1998 NHIS ≥ 50 years. Women ages 40 to 49 years were excluded from the analysis since variation in mammography recommendations by various national and professional organizations exist for this age cohort, especially at the time of the initial data collection (i.e., 1998). The final sample size was 6,053 women who responded to questions regarding mammography use and for whom independent data were available.

Research Design

This study employed a retrospective, nonexperimental research design. Retrospective analysis refers to the investigation of phenomena or events that have already occurred (i.e., dependent variable) in order to understand antecedent factors or underlying characteristics (i.e., independent or predictor variables) (Polit & Hungler, 1999). For example, in this study mammography use in the previous year (the event) was examined to determine the association or influence of certain factors or characteristics (e.g., types of disability, race, etc.) upon the utilization of mammography.

The study is classified as nonexperimental because it lacks elements found in experimental and quasi-experimental research such as randomization or random assignment into treatment groups, manipulation of treatments/interventions, and

experimental control (Campbell & Stanley, 1963; Polit & Hungler, 1999). This study may also be classified as ex post facto research. Ex post facto research is conducted after variations in the dependent variable have occurred (Kerlinger, 1973; Polit & Hungler, 1999). The goal of ex post facto research is to understand the relationships among the phenomena without any intervention by the researcher (Polit & Hungler, 1999). Because the affect or influence of the independent variable(s) on the dependent variable has occurred previously (i.e., mammography use in the previous year), it is difficult to infer causal relationships due to the lack of manipulative control of treatments (Polit & Hungler, 1999). Last, the research is cross-sectional in nature in that it used data collected from individuals at one point of time in a given year (Polit & Hungler, 1999). Specifically, one year of data (i.e., 1998) from a secondary data source collected by the NCHS was used to conduct the analysis.

Plan of Analysis

In this section of Chapter 3, the analytic strategy for evaluating the factors influencing mammography utilization among disabled women ≥50 years is discussed. First, the study variables, listed in Table 10, are described. These measures are discussed in groups (i.e., dependent and independent variables). Second, the statistical analysis employed is discussed, including the particular statistical software used.

Study Variables

Dependent Variable

As discussed in the review of the literature, mammography is an important method for the early detection of breast cancer. Cancers detected in their earlier stages are associated

Table 10

Study Variables, Measurement Classifications, and NHIS Data Files

Type of Variable	Measure	Measurement Classification	Data File
Dependent			
Mammography use in previous year		Dichotomous (2 = yes; 1 = no)	PREVADLT
Independent			
Self-reported disabilities			
	Activities of daily living	Dichotomous (2 = yes; 1 = no)	PERSONX
	Instrumental activities of daily living	Dichotomous (2 = yes; 1 = no)	PERSONX
	Cognitive limitations	Dichotomous (2 = yes; 1 = no)	PERSONX
	Work limitations	Dichotomous (2 = yes; 1 = no)	PERSONX
Environment			
	Region	Categorical (reference group = South) 1 = Northeast 2 = South 3 = Midwest 4 = West	PREVADLT
	Metropolitan statistical area	Dichotomous (2 = no; 1 = yes)	PREVADLT

Table 10 (continued)

Type of Variable	Measure	Measurement Classification	Data File
Population characteristics			
	Age	Categorical (reference group = 50-59 years) 1 = 50-59 years 2 = 60-69 years 3 = 70-79 years 4 = 80 ≥ years	PERSONSX
	Race	Categorical (reference group = Caucasian) 1 = Hispanic 2 = Caucasian 3 = African-American 4 = Other race/ethnicity	PREVADLT
	Education (HS graduate)	Dichotomous (2 = yes; 1 = no)	
	Income (income ≥ $20,000)	Dichotomous (2 = yes; 1 = no)	PREVADLT
	Significant other	Dichotomous (2 = yes; 1 = no)	PREVADLT

Table 10 (continued)

Type of Variable	Measure	Measurement Classification	Data File
	Health insurance	Categorical (reference group = no health insurance) 1 = no insurance 2 = private insurance 3 = public insurance 4 = private and public insurance	PERSONSX
Health behaviors			
	Smoking status	Dichotomous (2 = yes; 1 = no)	PREVADLT
	Previous clinical breast exam	Dichotomous (2 = yes; 1 = no)	PREVADLT
	Usual source of care	Dichotomous (2 = yes; 1 = no)	SAMADULT
	Barriers to health care use	Categorical (reference group = 0 barriers) 1 = no barriers 2 = 1-2 barriers 3 = 3-5 barriers	SAMADULT
	Volume of health care use (in previous year)	Dichotomous (2 = $\geq$ 10 visits; 1 = $<$ 10 visits)	PERSONSX
Health Outcomes			
	Obesity	Dichotomous (2 = yes; 1 = no)	SAMADULT
	Previous breast cancer	Dichotomous (2 = yes; 1 = no)	SAMADULT

Table 10 (continued)

Type of Variable	Measure	Measurement Classification	NHIS Data File
	Other comorbid conditions	Categorical (reference group = 0 conditions) 1 = 0 conditions 2 = 1-2 conditions 3 = 3- 4 conditions	SAMADULT

Note. For all dichotomous variables the "1" level is the reference group.

with better prognoses and survival rates. Despite its proven efficacy, mammography rates for various subpopulations in the U.S. often do not meet established goals (e.g., Healthy People) (NCHS, 1999). Thus, analysis of the various factors that influence mammography utilization by the total U.S. population and selected subpopulations is important to ensure preventive health care is utilized in an equitable manner.

Mammography utilization was evaluated based on self-reporting. The dependent variable in this study was self-reported use of mammography in the previous year (MAMMO). The MAMMO variable underwent two stages of coding. It was derived using a variable from the PREVADLT file regarding mammography use (entitled MAM in the NHIS). The particular question is: "A mammogram is an x-ray taken only of the breasts by a machine that presses the breast against a plate. Have you ever had a mammogram?" Women responding 'yes' to having ever had a mammogram were coded as '2.' Women responding 'no' to having ever had a mammogram were coded as '1.'

Further coding occurred for women who responded 'yes' to MAM. The individual's response to "When did you have your most recent mammogram? Was it a year ago or less, more than 1 year but not more than 2 years, more than 2 years but not more than 3 years, more than 3 years but not more than 5 years, or over 5 years ago?" Each response was dichotomized. Women responding to the most recent mammogram as 'a year ago or less' were coded as '2.' All other responses were coded as '1.'

Independent Variables

As discussed in the review of the literature, disabled women undergo mammography examinations less frequently than do nondisabled women. However, it is

difficult to analyze this association due to the various definitions of disability. As discussed, disability can be defined as limitations in one's daily activities, ability to work, as well as cognitive capacity. Because the definitions of disability are varied, it is important to include a variety of measures to analyze properly their influence on mammography utilization. Therefore, the independent variables of interest for this study were associated disability measures. They included limitations in daily activities (i.e., ADL and IADL), work, as well as the presence of cognitive limitations. The operational definitions and derivations of the independent variables for disability from the data are:

Activities of daily living (ADL) was derived from the PLAADL variable from the PERSONX data set. The original NHIS question queried self-reported need for help with personal care needs (e.g., eating, bathing, dressing, or getting around inside the home) due to physical, mental, or emotional problems. Any respondent who reported needing help with any of the activities are recorded as having an ADL limitation. Persons responding 'yes' to the need for help with personal care needs were coded as '2.' Persons without ADL limitations were coded as '1.'

The measure of limitations in instrumental activities of daily living (IADL) was derived from the dichotomous PLAIADL variable: "Because of a physical, mental, or emotional problem, do/does [the respondent] need the help of other persons in handling ROUTINE NEEDS, such as everyday household chores, doing necessary business, shopping, or getting around for other purposes?" In the original NHIS, any respondent reporting limitation (s) in one or more of the routine needs was coded as having an IADL limitation. This variable was maintained as a dichotomous variable as in the original data

set with those women reporting IADL limitations coded as '2.' Women who did not report IADL limitations were coded as '1.'

As discussed in the literature review, the ADA defines a physical or mental impairment as a disability only if limiting one's "major life activity," such as working. Consequently, limitation in one's ability to work (WORKLIM) was measured based on the response to the survey question (PLAWNOW) "Does a physical, mental, or emotional problem NOW keep [the respondent] from working at a job or business?" This variable was a dichotomous measure. Persons responding 'yes' to a work limitation were coded as '2.' Persons without work limitations were coded as '1.'

Cognitive limitations (COGNITIV) was a dichotomous variable based on if the person is reported limitation in any way because of difficulty remembering or because of periods of confusion. Persons who self-reported a cognitive limitation were coded as '2.' Persons without cognitive limitations were coded as '1.'

For reporting purposes, the aforementioned limitation factors were combined to form a variable termed DISABLED. This variable is a dichotomous variable measuring $\geq$ 1self-identified limitations (i.e., ADL, IADL, cognitive, or work limitation [s]). Persons having 0 limiting conditions were classified as nondisabled. This variable is used as the primary method of grouping the disabled population by any noted limitation. It is used for crosstabulation of results for the disabled.

Mammography utilization is influenced by a variety of factors. The health services utilization model provides a guiding framework for conceptualizing and identifying many of the influential factors and characteristics. Examples of factors that

influence mammography utilization, as identified in the literature, include characteristics of the individual (e.g., age, household income) as well as the influence of the health care environment. In addition, women's health care behaviors also influence their use of mammography. Because mammography utilization is mediated by multiple factors, it is important to include other variables for proper analysis of the influences of disability on mammography use. Specific examples of the coding for the various levels of the variables will be discussed in addition to their operational definitions.

Environment. In the NHIS, all personal identifiers are removed before public release. Therefore, the formation of detailed environmental variables was limited due to the inability to link NHIS person-level data to other data sources at the individual level. Nonetheless, extant measures in the NHIS served as proxies to evaluate any broad geographic factors that influence mammography utilization.

Geographic region (REGION) was a categorical variable based on the original NHIS variable REGION. Respondents' location of residence included the following regions of the U.S.: Northeast, Midwest, South, and West. The SUDAAN statistical program allows the user to code categorical variables in numerical fashion as well as to specify the level serving as the reference category (Shah, Barnwell, & Bieler, 1997). Therefore, REGION consisted of four levels (1 = Northeast, 2 = South, 3 = Midwest, and 4 = West). Women residing in the South served as the reference group since they are the largest category (Hosmer & Lemeshow, 1989).

The influence of patient residence or location was assessed using a dichotomous measure for residency in a metropolitan statistical area (MSA). This variable was based

on the NHIS variable MSASIZEP, in which the respondents' town or city of residence was coded as either a metropolitan statistical area (MSA) or not based on population size. An MSA is a county or group of adjoining counties containing at least one urbanized area. The population must consist of ≥ 50,000 inhabitants. For this study, the MSASIZEP variable from the NHIS was coded as a dichotomous variable. Persons residing in a non-MSA are coded as '2'; persons residing in an area classified as an MSA are coded as '1.'

Population characteristics. Age (AGE) was measured as a categorical variable for this study based on data derived from the DOB_Y_P variable in the PERSONSX data file. In the original NHIS data set, the self-reported year of birth was ascertained. To determine the respondent's age, the individual's year of birth was subtracted from 1998 (i.e., the year the survey was completed). The numerical result was the respondents' age and was represented by the following categories: 1 = 50-59 years; 2 = 60-69 years; 3 = 70-79 years; or 4 = ≥ 80 years. Women 50-59 years of age served as the reference group.

Race (RACECAT) was self-reported race and ethnicity classified into four categories: Caucasian, African-American, Hispanic, or other. RACECAT was first derived using the HISPCODE variable in the NHIS. HISPCODE was a recoded variable in the NHIS based on several questions on self-reported race and/or ethnicity. The categories of HISPCODE are Hispanic, non-Hispanic white, non-Hispanic black, or other. These categories of HISPCODE were maintained for this study, although they are renamed Hispanic, Caucasian, African-American, or other. The RACECAT levels were:

1 = Hispanic; 2 = Caucasian; 3 = African-American; 4 = other race/ethnicity. The Caucasian category (level 2) was the reference group.

The measure of the individuals' educational attainment was derived from the NHIS variable EDUC. EDUC indicates the highest level of school completed or the highest degree received. For this study, the original NHIS categorical variable was recoded as a dichotomous variable named high school graduate (HSGRAD). If respondents indicated graduation from high school, receipt of a general education diploma (GED) or equivalent, or completion of some college or higher, then that individual was termed 'high school graduate.' 'High school graduates' were coded as '2.' Persons who attended--but did not complete--high school (or a lower grade level) were classified as 'non-high school graduate' and subsequently coded as '1.'

Total household income (INCOME) served as a proxy for socioeconomic status. The INCOME variable is a dichotomous classification of self-reported household income and was derived from the AB_BL20K variable in the NHIS. For AB_BL20K, respondents' total household income was coded as a categorical variable: ≥$20,000; < $20,000; or those who refused to answer the question. The household income amount was then assigned to each member of the family. In this study, INCOME was recoded as a dichotomous variable using the $20,000 annual household income as the threshold. Women with household incomes < $20,000 were coded as '2.' Women with household incomes ≥ $20,000 were coded as '1.' Women who did not respond to the question were deleted in this study.

Presence of a self-reported significant other (SIGOTHER) was derived from respondents' self-reported marital status. The multiple categories of response in the NHIS variable R_MARITL were recoded as a dichotomous variable. 'Married' consisted of all persons reporting as 'married,' or 'living with a partner,' regardless of whether the spouse resided in the household. Married/cohabiting women were coded as '2.' Women who are 'widowed,' 'divorced,' 'separated,' or 'never married,' were classified as 'unmarried' and coded as '1.'

Health insurance (INSURANC) represents an important enabling factor that influences health care use. This variable indicated the presence of and type of health insurance reported by the NHIS respondents. INSURANC was derived from self-reported presence of Medicare, Medicaid, private health insurance, or no health insurance coverage using the MEDICARE, MEDICAID, and PRIVATE, or NOTCOV variables, respectively. Persons reporting other types of government-sponsored health insurance (e.g., Indian Health Service, CHAMPUS, etc.) were coded as having 'public' health coverage based on self-reported presence of health care coverage measured via the Indian Health Service (IHS), military (MILITARY), state-sponsored (OTHERPUB), or other governmental insurance (OTHERGOV) variables. INSURANC was recoded as a categorical variable with the following levels of reported health insurance coverage: 1 = no reported health insurance coverage (reference group); 2 = private health insurance only; 3 = public health insurance only; 4 = public and private health insurance.

Health behaviors. Smoking status (SMOKER) was the respondents' self-reported smoking status. In the NHIS PREVADLT file, smoking status was originally determined

based on a variety of questions regarding smoking experience and frequency. Data were extracted from the SMKSTAT1 variable in which one's status was categorized as 'current,' 'former,' or 'never' having been a smoker. In this study, the SMOKER variable was recoded as a dichotomous measure consisting of current smokers versus nonsmokers. Nonsmokers consisted of those who reported 'never' smoked as well as those stating they were a 'former smoker.' Smokers were coded as '2' and nonsmokers as '1.'

Previous clinical breast examination (CBE) is a proxy measure of a woman's breast cancer preventive behavior. In addition, it may also serve as indication of the influence of a physician or other health care professional. CBE was a dichotomous variable derived from self-reported breast physical examination (conducted by a doctor or medical assistant) and length of time since the examination. Women who reported a CBE a year ago or less were classified as having had a CBE in the previous year. Women who had a CBE greater than a year ago or who reported never having had a CBE were categorized as not having had a CBE. Women who self-reported a CBE in the previous year were coded as '2.' Women who did not have a CBE in the previous year were coded as '1.'

Usual source of care (USUALCR) represents the individual's self-reported presence of a usual source of health care, derived from AUSUALPL variable. This variable may indicate the influence of a health care provider. For the AUSUALPL question, the respondent was asked "Is there a place that you USUALLY go to when you are sick or need advice about your health?" The categorical NHIS variable AUSUALPL

was coded as a dichotomous variable for this study. Respondents who responded 'yes' or reported one of more places of care were coded as having a source of care (i.e., '2'). Persons who stated 'no' usual place of care were coded as '1.'

Barriers to health care use (BARRIER) is the presence of self-reported barriers or difficulties in accessing health care services. BARRIER was constructed as a categorical variable based on several NHIS variables to evaluate reported barriers to health care (i.e., waiting times too long in the doctor's office [AHCDLYR3], clinic/doctor's office not open when convenient [AHCDLYR4], lack of transportation [AHCDLYR5], delayed care due to cost(s) [PDMED12M], and no care due to cost(s) [PNMED12M]). In this study, respondents were classified as having 0 barriers (group 1, reference group), 2 = 1-2 barriers, or 3 = 3-5 self-reported barriers to accessing/obtaining health care.

Volume of health care utilization (VOLUME) was a measure of the amount of health care consumed by the individual in the previous 12 months. The variable was derived from the NHIS variable P10DVYR in which patients were asked: "During the past 12 MONTHS did [respondent] receive care from doctors or other health care professionals 10 or more times?" VOLUME was maintained as a dichotomous variable. Persons reporting $\geq$ 10 visits were coded as '2.' Persons reporting $<$ 10 visits serve as the reference group and were coded as '1.'

Health outcomes. Obesity (OBESITY) served as a proxy indicator of health status based on the individual's calculated body mass index (BMI). In the NHIS, the respondents' BMI was calculated using reported measures of weight (pounds) and height

(inches). First, self-reported weight and height measures were converted to kilograms and meters, respectively. The formula for BMI is:

$$BMI = Weight\ (kg)/Height(m)^2$$

rounded to 2 decimal places. For women, a healthy weight consisted of a BMI score between 19-24 (NCHS, 2000). Obesity was defined as a BMI score ≥ 30. For this study, OBESITY was a dichotomous variable with persons having a BMI score ≥ 30 classified as obese and coded as '2.' All other BMI scores were classified as not obese and were coded as '1.'

Evaluated health status was measured according to previous history of breast cancer (BREASTCA). This dichotomous variable was derived from response to the question of whether the respondent had ever been told they had breast cancer (CNKIND5). Women who reported a previous history of breast cancer were coded as '2.' Women without a previous history of breast cancer were coded as '1.'

Other comorbid conditions (COMORBID) was a proxy for evaluated health status. Additional comorbid conditions other than obesity were assessed to determine the impact of concurrent medical conditions that may affect the health and health care of the respondent. A scale was constructed based on self-reporting of the following medical conditions: hypertension (HYPEV), coronary artery disease (CHDEV), myocardial infarction (MIEV), or stroke (STREV). Respondents received a score of '1' if any of the aforementioned conditions were reported; the maximum score was 4. After obtaining a maximum score, the number of comorbid conditions were converted to a categorical variable (i.e., 0, 1-2, or 3-4 self-reported comorbid conditions). Women with 0 comorbid

conditions comprised the reference group. Women with 0 comorbidities were coded as '1' (reference group); 1-2 comorbidities were coded as '2'; those with 3-4 comorbidities were denoted '3.'

Statistical Analysis

Both descriptive statistics and binary logistic regression were employed to analyze the data. Descriptive statistics were used to report frequency distributions of the study variables. Crosstabulations of the descriptive statistics by disability status and specified population characteristics were conducted. Last, correlation matrices were analyzed to display uni- and bivariate associations between the study variables and to test for potential collinearity between the independent variables and covariates.

To evaluate the independent effect of disability status on the likelihood of undergoing mammography in the previous 12 months while controlling for the remaining factors, binary logistic regression was employed (Hosmer & Lemeshow, 1989; Sharma, 1996). Binary logistic regression (hereafter "logistic regression) is a widely used statistical method in health services research. The goal of this statistical method is to find "the best fitting and most parsimonious, yet biologically reasonable model" to describe the relationship between the dependent variable and the explanatory variables (i.e., independent and covariates) (Hosmer & Lemeshow, 1989, p. 1). Combinations of explanatory variables are used to predict the transformation of the dependent variable from one value (or condition) to another (Chan et al., 1999).

The logistic regression model for the probability of the event can be written:

$$\pi(x) = e^z / 1 + e^z$$

where

$$\underline{z} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots \beta_k X_k + \epsilon;$$

and

e is the base of the natural logarithms;

Z is a linear combination;

$\beta_0, \beta_1, \beta_2, \ldots \beta_k$ are coefficients estimated from the data;

X_1, X_2, $\ldots X_k$ are the explanatory variables; and

ϵ is an error term.

In logistic regression, the dependent variable must be dichotomous. However, explanatory variables can be continuous, categorical, or ordinal (Hosmer & Lemeshow, 1989). Binary or dichotomous variables are most often coded as 1 and 2 (or 0 and 1 depending upon the statistical software package). The creation of design variables to analyze categorical variables is not necessary with the SUDAAN statistical package. Instead, categorical variables can be coded as 1, 2, 3, 4, etc. Results are expressed as odd ratios, defined as the ratio of the probability of one group or factor having a particular outcome as compared to another group (reference group) having the same outcome. In addition to odds ratios, 95% confidence intervals were also calculated.

Model fit was determined by analyzing various statistics derived from the logistic regression analysis. Common statistics to evaluate model fit include the –2 Log Likelihood and the Wald statistic. The –2 Log Likelihood, also called the deviance, is a measure of the goodness-of-fit and is used to determine if the addition of the independent variables significantly improves the model (Sharma, 1996). Essentially, the smaller the

value the better the fit. In logistic regression, the observed values of the dependent variable are compared to predicted values obtained from models with and without the variable in question. The –2 Log Likelihood has a X^2 distribution with $n - q$ degrees of freedom, where q is the number of parameters in the model (Sharma, 1996). Likewise, the –2 Log L Ratio (also termed X^2 difference test) can also be used to determine model fit (Hosmer & Lemeshow, 1989; Sharma, 1996). This statistic is the difference between the –2 Log L for the model with the intercept only and the independent variables, and the –2 Log L for the model with only the intercept. It has a X^2 distribution with the df equal to the difference in the respective degrees of freedom (Sharma, 1996). Rejection of the null hypothesis implies that the inclusion of independent variables improves model fit (Hosmer & Lemeshow, 1989; Sharma, 1996). In this study, the –2 Log L Ratio is reported with the logistic regression results.

The Wald X^2 statistic (W) (also known as Wald F statistic) can be used to assess the statistical significance of each independent variable (Sharma, 1996). The Wald F statistic may be represented as:

$$W = \hat{\beta}/SE\ (\hat{\beta})$$

and can be evaluated at an appropriate level of statistical significance (e.g., $\alpha = .05$) (Hosmer & Lemeshow, 1989; Sharma, 1996).

To evaluate the impact of independent variables and covariates, the relative risk was calculated. Termed 'odds ratios,' this measure of relative risk can clarify the influence or importance of an explanatory or independent variable. For example, if an

explanatory variable is calculated to have an odds ratio of 8, it indicates that the event is 8 times more likely to occur in the presence of the explanatory variable.

Interaction terms were also included in the logistic regression equation and tested using the Wald F statistic ($\alpha = .05$). Interaction is an association between two independent variable based on particular levels of the variable that unequally influence the dependent variable. Consequently, the association between the independent and dependent variable differs or depends on the level of the independent variable (Hosmer & Lemeshow, 1989). A possible interaction effect in this study, for example, might concern the influence of age and disability on mammography use. No interaction effect would indicate that disability influences mammography use regardless of age. However, an interaction between the age and disability variables might reveal disability having a greater influence on mammography use for women with advanced age as compared to younger women. Last, multicollinearity was tested among independent variables by analyzing the correlation matrices. The level of significance for correlation was $\alpha = .05$.

Data were examined at the patient level using SUDAAN (release 7.5.6). SUDAAN is a recommended statistical program for analyzing NHIS data (NCHS, 2000). The SUDAAN statistical package was used due to its ability to estimate appropriate standard errors and conduct statistical tests, accounting for both sample weights for respondents and the complex survey design. This was necessary due to the complex survey design (NCHS, 2000) (see Appendix A for details regarding SUDAAN coding). Supplementary analysis was conducted using the Statistical Program for the Social Sciences (SPSS) Release 10.0.05.

Hypothesis Testing

Table 11 summarizes the study hypotheses and the statistical methods employed to test each. For all statistical testing, an $\alpha = .05$ is used. To test the hypotheses comparing mammography rates between disabled and nondisabled women based on residence in a MSA or non-MSA (i.e., H1A and H1B), mammography rates were calculated for women who report various disabilities compared to women without disabilities in rural and urban settings. A test of proportions (two-tailed) was employed to compare if the proportions between groups are equivalent.

Whether or not statistically significant differences exist in mammography rates for women with disabilities and nondisabled women across regions of the U.S. (H1C) was tested using chi square analysis and test of proportions (two-tailed). Likewise, chi square was used to compare mammography rates among disabled and nondisabled women based on race/ethnicity (H2A and H2B).

A test of proportions (two-tailed) was used to compare mammography rates between disabled and nondisabled women based on the presence of cognitive limitations and income level (H2C - H2E). Examination of differences in mammography rates among disabled and nondisabled women according to type of health insurance was tested via chi square analysis (H2F).

A test of proportions (two-tailed) were used to evaluate mammography utilization among disabled and nondisabled women based on the use of CBE, smoking status, as well as conditions such as obesity (H3A, H3B, H4A, H4B). The association of the level

Table 11

Study Hypotheses and Statistical Methods

Hypothesis	Statistical Method
H1A. No statistically significant differences exist in mammography rates for disabled women (i.e., presence of any ADL, IADL, cognitive, and/or work limitation [s]) residing in non-MSA locales compared to nondisabled women residing in non-MSA locales.	Test of proportions
H1B. No statistically significant differences exist in mammography rates for disabled women residing in MSA-designated locales compared to nondisabled women residing in MSA-designated locales.	Test of proportions
H1C. No statistically significant differences exist in mammography rates for women with disabilities (i.e., presence of any ADL, IADL, cognitive, and/or work limitation [s]) and nondisabled women across regions of the U.S.	Chi-square Test of proportions
H2A. No statistically significant differences exist in mammography rates for nondisabled (i.e., presence of any ADL, IADL, cognitive, and/or work limitation [s]) Caucasian women as compared to nondisabled minority women.	Chi-square Test of proportions
H2B. No statistically significant differences exist in mammography rates for disabled Caucasian women as compared to disabled minority women.	Chi-square

Table 11 (continued)

Hypothesis	Statistical Method
H2C. No statistically significant differences exist in mammography rates for women with and without cognitive limitations.	Test of proportions
H2D. No statistically significant differences exist in mammography rates among low-income (i.e., < $20,000 annual household income) disabled women compared to low-income nondisabled women.	Test of proportions
H2E. No statistically significant differences exist in mammography rates among higher-income (i.e., > $20,000 annual household income) disabled women compared to higher-income nondisabled women.	Test of proportions
H2F. No statistically significant differences exist in mammography rates among disabled and nondisabled women according to type of health insurance.	Chi-square
H3A. No statistically significant differences exist in mammography utilization rates among disabled and nondisabled women according to smoking status.	Test of proportions
H3B. No statistically significant differences exist in mammography utilization rates among disabled and nondisabled women according to CBE utilization in the previous year.	Test of proportions

Table 11 (continued)

Hypothesis	Statistical Method
H4A. No statistically significant differences exist in mammography rates among obese, disabled women as compared to obese, nondisabled women.	Test of proportions
H4B. No statistically significant differences exist in mammography rates among nonobese disabled women as compared to non-obese, nondisabled women.	Test of proportions
H4C. No statistically significant differences exist in mammography rates among disabled and nondisabled women by level of comorbid conditions (i.e., hypertension, coronary artery disease, myocardial infarction, or stroke).	Chi-square Test of proportions
H5. Mammography utilization is not influenced by the presence of a disability, after controlling for environmental, population characteristics, health behaviors, and health outcomes.	Binary logistic regression

of comorbid conditions on mammography utilization among disabled and nondisabled women was assessed via chi square analysis.

Finally, the influence of mammography utilization in the previous year by the presence of various disability measures after controlling for environmental, characteristics of the population, health behaviors and health outcomes (H5) was tested using logistic regression. In H5, the independent variables measuring disability and limitations were included in the model along with other covariates. Inclusion of demographic, socioeconomic, and other variables of relevance, as identified in the literature review, allows for the simultaneous control of other explanatory factors to better evaluate the influence of disability on mammography utilization. Specified interaction terms are also included in a second regression analysis. The model for the binary logistic regression analysis was:

mammography utilization = f (β0 + β1 ADL + β2 IADL + β3 cognitive limitation + β4 work limitation + β5 region + β6 MSA residency + β7 age + β8 race + β9 education + β10 income + β11 significant other + β12 health insurance + β13 smoking status + β14 previous CBE + β15 usual source of care + β16 barriers to health care use + β17 volume of health care use + β18 obesity + β19 other comorbid conditions + β20 previous history of breast cancer).

Study Limitations

As in any study, limitations exist in the research design and sources of data. This study design reveals the relationships that do or do not exist between the aforementioned variables. However, the research design does not control for threats to internal validity

(e.g., history, testing). Therefore, other reasons may exist for explaining the variation in the dependent variable. A limitation of the cross-sectional design is the static nature of the observations. One is unable to evaluate events occurring over time (Campbell & Stanley, 1963). For example, this study was restricted to evaluation of mammography use in 1998 without knowledge of the individual's previous utilization pattern. The possibility exists that the individual underwent consistent annual mammography over a period yet failed to obtain an examination in 1998. A limitation also exists in the use of self-reported data or survey data (Polit & Hungler, 1999). The potential exists that respondents may not accurately answer questions posed by the interviewer.

No consensus exists regarding the types of limitations and conditions that constitute a disability. The definition of disability used in this study differs from those found commonly in health services literature. In this study, the definition of disability is broadened to include both the conventional measures of ADLs and IADLs as well as other conditions such as cognitive and work limitations. Consequently, the DISABLED measure may encompass more persons than previous research and, the estimates may not reflect current population estimates.

Limitations also exist when using secondary data, such as the NHIS. Original data were not collected for the purpose of this study. Inaccuracies may exist because of potential biases in data collection, coding, etc. Furthermore, the measures and variables provided in the NHIS may not be ideally suitable for this study. For example, an exact measurement of the health behavior dimension in the health services utilization model is not found in the NHIS, resulting in the need to include proxy measures. Consequently,

some variables may not accurately measure the intended factors. A final limitation in using the NHIS is the inability to link person-level data to other sources of data to strengthen the analysis. Thus, the study is restricted to only those variables included in the NHIS. Considering these limitations, careful evaluation and analysis of the results is warranted.

Summary of Methods

This chapter described the methodology used in the study. The 1998 NHIS, a nationally representative survey of the civilian, noninstitutionalized population in the U.S., is the main source of data for this study. A major benefit of this data source is the ability to calculate nationally representative estimates of health care utilization. Three different NHIS data files were combined for this analysis. Analysis was conducted at the individual or patient-level, consisting of women ≥50 years. Women for whom mammography use data are available were included in the sample population. The study is a nonexperimental, ex post facto design common in health services research. Advantages and limitations of the design were discussed.

Using the health services utilization model, variables measuring the various model dimensions were discussed and operationalized. Use of these study variables allow for a comprehensive examination of the factors that influence mammography use by disabled women. The statistical methods consisted of basic descriptive and binary multivariate statistics. Binary logistic regression was used since the dependent variable is dichotomous. This method allowed for determining the strength of explanatory variables in predicting an individual's use of mammography in the previous year.

CHAPTER 4: RESULTS

This chapter begins with a discussion of the study sample and population of women ≥ 50 years old examined in this study. Following a description of the population, the influence of disability and other factors (i.e., environment, population characteristics, health behaviors, and health outcomes) on the utilization of mammography in the previous year are examined. Specific hypotheses are tested and results are summarized.

Characteristics of the Study Sample

This study sample consisted of 6,053 U.S. women ≥50 years for whom mammography and other independent data were available. Based on weighting factors provided in the NHIS data set, these women represent a study population of 30,894,424 women. Statistical testing was conducted using the weighted population of approximately 30.8 million women. A total of 1,383 women ≥50 years from the NHIS PREVADLT file were excluded due to missing or incomplete data.

Comparison was made between the characteristics of the study sample versus those excluded from the sample. The study and excluded samples were equivalent based on the ADL, IADL, cognitive limitation, work limitation, and usual source of care variables. However, the samples differed according to the CBE utilization, age, and race/ethnicity variables. The study sample (i.e., respondents) had lower proportions of women in the following groups: ≥ 80 years, Caucasian, other race/ethnicity, as well as

those who utilized CBE in the previous year as compared to the excluded sample. Likewise, the study sample had greater proportions of women who were ages 50-59 and 60-69 years as well as of Hispanic race/ethnicity.

Table 12 summarizes characteristics of the total study population of women ≥50 years. Approximately 55% of the study sample reported receiving mammography in the previous year. The proportion of the sample population with different types of limitations varied. Work limitations were the more frequent limitation within the study population (14.66%). Although women with self-reported ADL limitations comprised only 3.25% of the study population, IADL limitations were more frequent at 9.98% of the study population. Women with cognitive limitations comprised 4.76% of the population. However, the various types of limitations were not mutually exclusive. Approximately 9% of the study population reported ≥ 2 of the limitations addressed in this study (i.e., ADL, IADL, cognitive, or work limitation [s]) (see Figure 5). Overall, the disability prevalence rates in this study are similar to McNeil and Binette's (2001) study as presented in Table 4.

In analyzing environmental factors, over one-third of the sample resided in South (35.04%) as compared to 21.03% in the Northeast and 25.39% in the Midwest. Slightly more than three-fourths (76.54%) of the study population resided in MSA-designated locales.

Over one-third of the sample population were ages 50-59 with approximately one-quarter between the ages of 60-69 and 22% ages 70-79. Caucasians comprised the

Table 12

Characteristics of the Study Sample (n = 6,053)

Characteristic	Sample Number	Weighted Population Prevalence (%)
Mammography utilization (prior year)		
Yes	3,192	54.48
No	2,861	45.52
Disability[a]		
Activities of daily living	219	3.25
Instrumental activities of daily living	681	9.98
Cognitive limitations	321	4.76
Work limitations	984	14.66
Environmental factors		
Region		
Northeast	1,225	21.03
Midwest	1,455	25.39
South	2,182	35.08
West	1,191	18.50
MSA-designated locale		
Yes	4,698	76.54
No	1,355	23.46
Population characteristics		
Age (years)		
50-59	2,146	38.43
60-69	1,600	26.84
70-79	1,480	22.91
≥ 80	827	11.82

Table 12 (continued)

Characteristics	Sample Number	Weighted Population Prevalence (%)
Race/ethnicity		
Hispanic	559	6.04
Caucasian	4,592	82.03
African-American	765	9.23
Other	137	2.69
Educational level		
High school graduate	4,316	74.43
< high school	1,737	25.57
Income (annual household)		
≥ $20,000	3,493	67.19
< $20,000	2,560	32.81
Significant other		
Yes	2,492	56.13
No	3,561	43.87
Health insurance		
No insurance	397	6.09
Private only	2,236	41.50
Public only	1,423	20.05
Private and public	1,997	32.36
Health behaviors		
Smoking status		
Yes	1,059	16.95
No	4,994	83.05
Clinical breast exam (previous year)		
Yes	3,667	62.19
No	2,386	37.81

Table 12 (continued)

Characteristics	Sample Number	Weighted Population Prevalence (%)
Usual source of care		
Yes	5,699	94.46
No	354	5.54
Barriers to health care use		
0	5,138	86.40
1–2	842	12.57
3-5	73	1.03
Volume of health care use		
< 10 visits	4,798	80.56
≥10 visits	1,255	19.44
Health outcomes		
Obese		
Yes	1,597	25.41
No	4,456	74.59
Previous breast cancer[b]		
Yes	285	33.78
No	545	66.22
Comorbid conditions (number of)		
0	2,991	51.12
1-2	2,859	45.71
3-4	203	3.17

[a]Disability categories are not mutually exclusive.

[b]Results based on 830 total responses.

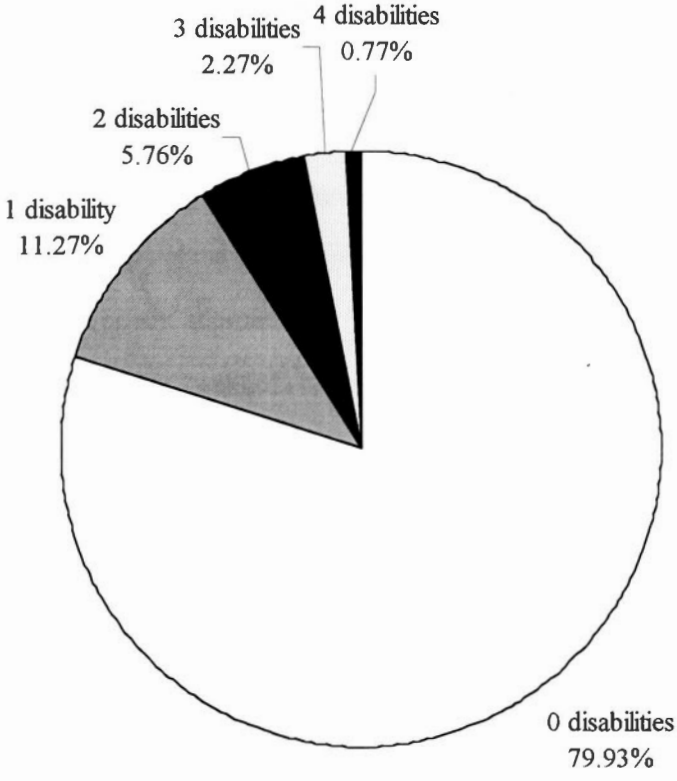

Figure 5. Prevalence of multiple disabilities among study sample.

majority of women ≥50 years (82.03%). African-Americans comprised 9.23% and Hispanics 6% of the study population. Nearly 70% of the sample reported annual household incomes ≥ $20,000 and approximately 75% were high school graduates. Over one-half (56.13%) of the sample had significant others (i.e., married, cohabiting with partner) compared to those who were single, divorced, or widowed.

Over 40% of the study population had private sources of health insurance as compared to 20% who had only public insurance (e.g., Medicaid, Medicare, CHAMPUS, etc.). Approximately 32% of the study population had a combination of health insurance from both public and private sources.

Of the entire sample, over 60% had a CBE during the previous year. In addition, the sample population was predominately nonsmoking (83.05%) and nearly 95% reported having a usual source of health care. Approximately 86% of the women reported no barriers (e.g., waiting times too long, clinic/doctor's office not open when convenient, lack of transportation, delayed or no care due to cost [s]) upon their utilization of health care. Despite the positive health behaviors and factors, however, one-fourth (25.41%) were classified as obese and 45.71% had 1-2 comorbid conditions (e.g., hypertension, coronary artery disease, myocardial infarction, or stroke).

Comparisons of Disabled vs. Nondisabled Study Sub-samples

Table 13 compares the disabled and nondisabled sample based on variables examined in this study. In the following tables, 'disabled' refers to women who reported any of the following conditions: ADL, IADL, cognitive, or work limitation. Disabled

Table 13

Characteristics of the Disabled and Nondisabled Study Sample

Characteristic	Weighted Sample Prevalence (%) Disabled (sample n = 1,320)	Nondisabled (sample n = 4,733)	X^{2a}
Mammography in previous year	42.99	57.37	n/a
Disability[b]			
Activities of daily living	16.22	0	
Instrumental activities of daily living	49.76	0	
Cognitive	23.74	0	
Work	72.08	0	
Environmental factors			
Region			11.11*
Northeast	18.23	21.73	
Midwest	23.23	25.93	
South	34.30	35.08	
West	18.04	18.50	
MSA-designated locale			10.70**
Yes	71.90	77.71	
No	28.10	22.29	
Population characteristics			
Age (years)			142.92***
50-59	29.05	40.79	
60-69	21.34	28.22	
70-79	23.84	22.68	
≥ 80	25.77	8.31	

Table 13 (continued)

Characteristic	Weighted Sample Prevalence (%) Disabled (sample n = 1,320)	Nondisabled (sample n = 4,733)	X^{2a}
Race/ethnicity			25.96***
Hispanic	6.94	5.82	
Caucasian	77.42	83.19	
African-American	13.30	8.21	
Other	2.34	2.78	
Educational level			143.66***
High school graduate	56.10	79.03	
< high school	43.90	20.97	
Income (annual household)			240.20***
≥ $20,000	41.91	73.53	
< $20,000	58.09	26.47	
Significant other			107.90***
Yes	39.84	60.22	
No	60.16	39.78	
Health insurance			306.52***
No insurance	5.73	6.16	
Private only	17.28	47.57	
Public only	40.06	14.99	
Private and public	36.93	21.28	
Health behaviors			
Smoking status			5.70*
Yes	19.52	16.30	
No	80.48	83.70	
Clinical breast exam (previous year)			28.26***
Yes	54.34	64.16	
No	45.66	35.84	

Table 13 (continued)

Characteristic	Weighted Sample Prevalence (%) Disabled (sample n = 1,320)	Nondisabled (sample n = 4,733)	X^{2a}
Usual source of care			8.65**
Yes	96.11	94.05	
No	3.89	5.95	
Barriers to health care use			78.26***
0	75.30	89.19	
1-2	21.87	10.23	
3-5	2.83	0.57	
Volume of health care use			312.94***
<10 visits	52.93	87.50	
≥10 visits	47.07	12.50	
Health outcomes			
Obese			14.47***
Yes	30.40	24.16	
No	69.60	75.84	
Previous breast cancer[c]			1.30
Yes	30.55	35.09	
No	69.45	64.91	
Comorbid conditions			240.90***
0	29.33	56.59	
1-2	61.77	41.68	
3-4	8.90	1.73	

[a]Chi square analysis conducted on groups within categorical variables.

[b]Limitations are not mutually exclusive.

[c]Results based on 830 total responses.

*$p < .05$. **$p < .01$. ***$p < .0001$.

women (i.e., a proxy variable combining those women with any self-reported limitation) comprised 20.07% of the study sample. However, the proxy variable for disability used in this study should not be used for establishing national disability estimates beyond the analysis conducted in this study because the total population is not being measured. Notable are the statistically significant differences in the proportion of disabled women reporting mammography in the previous year as compared to nondisabled women (42.99% vs. 57.37%, respectively; $z = 646.83$; $p = .00$) (see Appendix B for results of statistical testing). The subsequent discussion is organized by the types of limitations and the four constructs of the health services utilization model for a population of approximately 30.8 million women.

Disability/Limitation(s)

Prevalence rates for the four types of limitations investigated in this study (i.e., ADL, IADL, cognitive, and work limitations) are indicated in Table 13. Note that these limitation categories are not mutually exclusive. Among the disabled study population, limitations in the ability to work (72.08%) and IADL limitations (49.76%) are more predominant. Nearly one-quarter of women with disabilities have self-reported cognitive limitations. Women with ADL limitations comprise 16.22% of the disabled population.

Environment

For both disabled and nondisabled women, nearly three times more women resided in MSA-designated locales as compared to non-MSA locales. Significant differences in residency, according to MSA designation are found ($X^2 = 10.70$; $p < .01$). Among disabled women, for example, 71.90% resided in MSA locales as compared to

28.10% in non-MSA locales. Greater proportions of nondisabled women resided in MSA-designated locales (77.71%). Significant differences in the region of residence of disabled and nondisabled women was also evident ($X^2 = 11.11$; $p < .05$). The greatest proportion of disabled and nondisabled women in the study population resided in the Southern region of the U.S. The smallest proportion of disabled and nondisabled women resided in the West.

Population Characteristics

Overall, significant differences in many sociodemographic factors exist when comparing disabled to nondisabled women. For example, significant differences exist in the age distribution of disabled versus nondisabled women ($X^2 = 142.92$; $p < .0001$). Disabled women tended to be older than nondisabled women in this study population. For example, 70.95% of women ≥ 60 years were disabled as compared to 59.21% of nondisabled women in the same age cohort ($z = 565.80$; $p = .00$) (see Appendix B for results of statistical testing).

Race/ethnicity was associated with the presence of a disability in the study population ($X^2 = 25.96$; $p < .0001$). Overall, a greater proportion of minorities was disabled except for the 'other' category. A greater proportion of African-American women was disabled (13.30%) as compared to their nondisabled counterparts (8.21%). The difference is statistically significant ($z = 345.96$; $p = .00$) (see Appendix B for results of statistical testing).

Disabled women had significantly lower levels of education as compared to nondisabled women in this study ($X^2 = 143.66$; $p < .0001$). Approximately 60% of

disabled women were high school graduates as compared to almost 80% of nondisabled women. Likewise, significant disparities in the annual household incomes of disabled and nondisabled women are also evident ($X^2 = 240.20$; $p < .0001$). The proportion of disabled women with lower incomes was more than double that of the nondisabled women. Approximately 58% of disabled women had annual household incomes < $20,000 compared to approximately 26% of nondisabled women ($z = 1456.33$; $p = .00$) (see Appendix B for results of statistical testing).

Table 13 reveals that a larger proportion of disabled women do not reside with significant others as compared to nondisabled women. Approximately 60% of the disabled cohort lacked significant others as compared to almost 40% of nondisabled women. Last, significant differences exist in health insurance coverage for disabled compared to nondisabled women ($X^2 = 306.52$; $p < .0001$). Although the proportions of women without health care coverage are similar, differences exist in the proportion of women having 'only private' and 'only public' health insurance. Only 17.39% of disabled women had a private source of health insurance as compared to 47.55% of nondisabled women. A larger proportion of disabled women (40.26%) had public sources of health insurance than nondisabled women. Overall, disabled women tended to rely upon public sources of insurance more than nondisabled women.

Health Behaviors

The proportion of disabled and nondisabled women classified as 'smokers' was similar yet statistically different ($X^2 = 5.70$; $p < .05$). Smokers comprised 19.52% of the disabled population compared to 16.30% of nondisabled women. A high proportion of

disabled and nondisabled women reported having usual source of health care, although a slightly larger proportion of disabled women (96.11%) reported a usual source of care as compared to the nondisabled cohort (94.05%) ($z = 225.88$; $p = .00$) (see Appendix B for results of statistical testing).

Regarding the receipt of a clinical breast exam (CBE) in the previous year, a significantly greater proportion of nondisabled women received the exam (64.16%) as compared to nondisabled women (54.34%) ($z = 442.33$; $p = .00$) (see Appendix B for results of statistical testing). Furthermore, disabled women had significantly higher levels of health care use (i.e., ≥ 10 visits) than did nondisabled women ($X^2 = 312.94$; $p = .00$). Despite the overall higher health care volumes, disabled women reported significantly higher levels of barriers to health care utilization than did their nondisabled counterparts ($X^2 = 78.26$; $p = .00$). In this respect, 21.87% of disabled women reported 1-2 barriers to health care use as compared to 10.23% of nondisabled women.

Health Outcomes

A significantly higher proportion of disabled women was classified as obese (30.40%) as compared to nondisabled women (24.16%) ($z = 306.12$; $p = .00$) (see Appendix B for results of statistical testing). Likewise, disabled women had significantly higher levels of comorbid conditions as compared to their nondisabled counterparts ($X^2 = 240.90$; $p < .0001$). Over 60% of disabled group had 1-2 comorbid conditions compared to nearly 42% of nondisabled women ($z = 917.49$; $p = .00$) (see Appendix B for results of statistical testing).

Data regarding diagnosed breast cancer in the disabled and nondisabled groups are based on a limited sample of 830 women for whom data were collected during the administration of the PREVADLT survey. Results for this subgroup indicate that a higher proportion of nondisabled women (35.09%) had been diagnosed previously with breast cancer as compared to disabled women (30.55%). This difference is statistically significant ($z = 658.49$; $p = .00$) (see Appendix B for results of statistical testing).

Mammography Utilization by Disabled and Nondisabled Women

The following sections present the proportion of disabled and nondisabled women who utilized mammography in the previous year, stratified by the various constructs derived from the health services utilization model. The results presented are national-level estimates of mammography utilization for the total U.S. population. Statistical testing was conducted using national-level estimates.

Disability/Limitation(s)

As indicated in Table 14, women with work limitations had the highest rates of mammography utilization in the previous year (43.80%), closely followed by those with self-reported IADL limitations (38.61%). Mammography utilization rates varied between the limitation types. The proportion of women utilizing mammography in the previous year with self-reported cognitive limitations was 34.36% compared to only 31.06% of women with ADL limitations. For comparison, the proportion of nondisabled women who reported mammography in the previous year was 57.37%.

Table 14

Weighted Population Prevalence for Mammography Utilization In the Previous Year

Characteristic	Proportion reporting mammography: Disabled (sample n = 1,320)	Proportion reporting mammography: Nondisabled (sample n = 4,733)	X^{2a}
Subsample population	42.99	57.37	
Disability[b]			
Activities of daily living			
Yes	31.06	n/a	
No	45.30	57.37	
Instrumental activities of daily living			
Yes	38.61	n/a	
No	47.32	57.37	
Cognitive			
Yes	34.36	n/a	
No	45.67	57.37	
Work			
Yes	43.80	n/a	
No	40.77	57.37	
Environmental factors			
Region			6.72
Northeast	46.06	61.03	
Midwest	44.37	56.91	
South	42.55	55.50	
West	39.49	57.17	
MSA-designated locale			15.34**
Yes	44.11	58.98	
No	40.12	51.74	

Table 14 (continued)

Characteristic	Proportion reporting mammography: Disabled (sample n = 1,320)	Proportion reporting mammography: Nondisabled (sample n = 4,733)	X^{2a}
Population characteristics			117.55**
Age (years)			
50-59	52.06	60.36	
60-69	50.74	59.92	
70-79	43.59	54.24	
≥80	25.79	42.54	
Race/ethnicity			14.80*
Hispanic	45.67	50.77	
Caucasian	42.54	58.69	
African-American	47.67	52.99	
Other	23.26	44.52	
Educational level			98.96**
High school graduate	48.25	60.88	
< high school	36.27	44.11	
Income (annual household)			137.49**
≥ $20,000	49.67	61.72	
< $20,000	38.17	45.28	
Significant other			69.42**
Yes	50.30	61.28	
No	38.14	51.44	
Health insurance			175.70**
No insurance	32.01	34.81	
Private only	63.69	64.31	
Public only	37.33	46.72	
Private and public	41.10	56.37	

Table 14 (continued)

Characteristic	Proportion reporting mammography: Disabled (sample n = 1,320)	Proportion reporting mammography: Nondisabled (sample n = 4,733)	X^{2a}
Health behaviors			
Smoking status			35.86**
Yes	40.66	45.02	
No	43.55	59.77	
Clinical breast examination (previous year)			1520.07**
Yes	73.15	83.51	
No	7.10	10.57	
Usual source of care			116.91**
Yes	43.92	59.64	
No	20.02	21.53	
Barriers to health care use			24.29**
0	44.90	58.14	
1-2	36.45	51.47	
3-5	42.78	42.19	
Volume of health care use			1.58
< 10 visits	40.11	56.13	
≥ 10 visits	46.22	66.02	
Health outcomes			
Obese			
Yes	48.66	58.42	1.66
No	40.51	57.03	
Previous breast cancer[c]			20.72**
Yes	73.20	73.10	
No	43.94	62.25	

Table 14 (continued)

Characteristic	Proportion reporting mammography: Disabled (sample n = 1,320)	Proportion reporting mammography: Nondisabled (sample n = 4,733)	X^{2a}
Comorbid conditions			11.53*
0	42.64	55.57	
1-2	43.40	60.39	
3-4	41.96	41.57	

[a]Chi square analysis conducted on groups within categorical variables.
[b]Limitations are not mutually exclusive.
[c]Results based on 830 respondents.
*$p < .01$. **$p < .0001$.

Environment

Environmental variables examined in this study include residence in an MSA-designated locale and region of the U.S. Table 14 indicates mammography rates for disabled and nondisabled women according to MSA-designation and region. An association between MSA locale and mammography utilization is evident ($X^2 = 15.34$; $p < .0001$). A significantly greater proportion of nondisabled women in MSA-designated locales (58.98%) utilized mammography in the previous year as compared to their disabled cohort (44.11%) ($z = 570.65$; $p = .00$) (see Appendix B for results of statistical testing). Likewise, nondisabled women consistently had higher mammography utilization rates as compared to disabled women in each of the four regions of the U.S. However, the association was not significant at $\alpha = .05$, meaning that mammography utilization was independent of region of residence. The highest utilization rates were found among women (i.e., both disabled and nondisabled) who resided in the Northeast. The lowest rate of mammography utilization among disabled women was found among women residing in the West (39.49%). Among the nondisabled cohort, however, women in the South had the lowest rate of mammography utilization (55.50%).

Population Characteristics

The utilization rates for mammography in the previous year were compared for disabled and nondisabled women based on a variety of sociodemographic factors. Age was associated with mammography utilization among disabled and nondisabled women ($X^2 = 117.55$; $p < .0001$). Mammography utilization rates decreased with increasing age. For example, the utilization rate among disabled 50-59 year old women

was double the rate for disabled women ≥ 80 years (52.06% vs. 25.79%). Similar declines in utilization rates were found among nondisabled women although the differences across age groups for utilization rates were not as large.

Likewise, an association between race/ethnicity and mammography utilization among disabled and nondisabled women is indicated ($X^2 = 14.80$; $p < .01$). Among the nondisabled cohort, the highest mammography utilization rates were found among Caucasian women (58.69%) with African-Americans having the second highest rates (52.99%). Women in the 'other' race/ethnicity category demonstrated the lowest rates of mammography utilization among disabled and nondisabled women. Among the disabled group, the race/ethnic group with the highest utilization rate was African-Americans (47.67%) followed by Hispanics (45.67%). Disabled Caucasian women demonstrated the third highest mammography utilization rate; approximately 43% of the disabled Caucasian population had a mammogram in the previous year.

Table 14 also indicates a strong association between education and the utilization of mammography among the disabled and nondisabled groups ($X^2 = 98.96$; $p < .0001$). Higher proportions of high school graduates underwent mammography in the previous year compared to those women with less than a high school education. This finding was consistent regardless of disability status. The greatest difference in utilization rates was found among high school graduates. Less than one-half (48.25%) of disabled high school graduates utilized mammography as compared to 60.88% of the nondisabled cohort ($z = 435.96$; $p = .00$) (see Appendix B for results of statistical testing).

A similar association between annual household income and mammography utilization was also found ($X^2 = 137.49$; $p < .0001$). Consistently, a greater proportion of disabled and nondisabled women with higher incomes (i.e., ≥ $20,000 annual household income) utilized mammography in the previous year as compared to women with < $20,000 annual household incomes. Among nondisabled women, approximately 60% of women with higher incomes underwent mammography in the previous year as compared to approximately 45% of women in the lower income category.

The presence of a self-reported significant other was also associated with mammography utilization in the previous year for both disabled and nondisabled women ($X^2 = 69.42$; $p < .0001$). Women with significant others had statistically higher rates of mammography utilization than those without significant others. One-half (50.30%) of disabled women with a significant other utilized mammography in the previous year compared to approximately 38% of those without a significant other ($z = 299.83$; $p = .00$) (see Appendix B for results of statistical testing).

Last of the population characteristics, a strong association between the presence/type of health insurance and mammography utilization among the study population was demonstrated in Table 14 ($X^2 = 175.70$; $p < .0001$). Women who lack health insurance consistently demonstrated the lowest mammography rates in both the disabled and nondisabled groups (32.01% vs. 34.81%, respectively). Women with private health insurance reported the highest mammography rates in both the disabled and nondisabled cohorts. The difference in mammography rates among disabled (63.69%) and nondisabled women (64.31%) reporting private health insurance was similar, yet

statistically significantly different ($z = 12.71$; $p = .00$) (see Appendix B for results of statistical testing). A public source of health insurance (e.g., Medicare, Medicaid, Indian Health Service, etc.) was associated with the second lowest rates of mammography utilization among both groups of women (i.e., disabled = 37.33% and nondisabled = 46.72%). However, women with combined private and public sources of health care demonstrated higher mammography rates than did women with only public sources of health care.

Health Behaviors

Strong associations among study health behavior variables and mammography utilization in the previous year are demonstrated in Table 14. Smoking status was associated with mammography utilization among the disabled and nondisabled populations ($X^2 = 35.86$; $p < .0001$). A significantly larger proportion of disabled nonsmokers utilized mammography in the previous year (43.55%) than did disabled smokers (40.66%) ($z = 58.05$; $p = .00$) (see Appendix B for results of statistical testing). Similar findings are found for nondisabled women; 59.77% of nondisabled, nonsmokers utilized mammography in the previous year as compared to only 45.02% of nondisabled smokers ($z = 545.71$; $p = .00$) (see Appendix B for results of statistical testing).

A very strong association between the utilization of a clinical breast examination (CBE) in the previous year and mammography is noted ($X^2 = 1520.07$; $p < .0001$). For example, 73.15% of disabled women who had a CBE in the previous year utilized mammography. However, among disabled women who did not undergo a CBE, only 7.10% had a mammogram in the previous year. This finding was also demonstrated

among nondisabled women. The mammography rate for nondisabled women who received a CBE in the previous year (83.51%) was also notably higher than the rate for nondisabled women who did have a CBE in the previous year (10.57%).

Mammography rates also varied significantly among disabled and nondisabled women who report a usual source of care (i.e., "Is there a place that you usually go to when you are sick or need advice about your health?") ($X^2 = 116.91$; $p < .0001$). Among disabled women, the mammography rate for women who reported a usual source of health care (43.92%) was more than double the rate for women who lacked a usual source of care (20.02%) ($z = 284.74$; $p = .00$) (see Appendix B). Similarly, a significantly higher proportion of nondisabled women who reported a usual source of care utilized mammography in the previous year (59.64%) as compared to the utilization among nondisabled women not reporting a usual source of care (21.53%) ($z = 1076.65$; $p = .00$) (see Appendix B).

Barriers to health care apparently made it more difficult to use mammography for both disabled and nondisabled women ($X^2 = 24.29$; $p < .0001$). For both disabled and nondisabled women, those women who reported 0 barriers to health care use had the highest rates of mammography utilization compared to women with $\geq$ 1 barriers. Among disabled women, 44.90% of the cohort who reported 0 barriers to health care use underwent mammography in the previous year. However, only 36.45% of disabled women with 1-2 barriers and 42.78% with 3-5 barriers utilized mammography in the previous year.

An interesting finding was the lower utilization rate among disabled women with 1-2 barriers as compared to other levels. A significantly lower proportion of disabled women with 1-2 reported barriers utilized mammography as compared to disabled women with higher barrier levels (i.e., 3-5 barriers) ($z = 50.60$; $p = .00$) (see Appendix B). This disparity was not found among the nondisabled population where the proportion of women utilizing mammography in the previous year decreased as barriers to care increased. For most levels of barriers to health care use, the proportion of nondisabled women utilizing mammography exceeded the rates for disabled women.

The volume of one's health care use was not associated with mammography utilization among disabled and nondisabled women ($X^2 = 1.58$; $p = .21$). Women with higher volumes of health care visits had higher rates of mammography utilization than do women with lower volumes of care. Among disabled women, only 40.11% of women with < 10 visits utilized mammography in the previous year as compared to 46.22% of women with ≥ 10 visits ($z = 153.51$; $p = .00$) (see Appendix B). The difference in mammography rates among nondisabled women was larger. Only 56.13% of nondisabled women with < 10 visits utilized mammography in the previous year as compared to 66.02% of women with ≥ 10 visits.

Health Outcomes

Concerning health outcomes variables, a significant association between obesity and mammography utilization among disabled and nondisabled women was not found ($X^2 = 1.66$; $p = .20$). A significantly larger proportion of obese, disabled women utilized mammography in the previous year (48.66%) as compared to nonobese, disabled women

(40.51%) ($z = 187.89$; $p = .00$) (see Appendix B for results of statistical testing). Among nondisabled women, the mammography rate for obese and nonobese women was more similar than among the disabled. However, due to the large sample size the statistical results are significantly different ($z = 59.93$; $p = .00$) (see Appendix B). A larger proportion of nondisabled women consistently utilized mammography than disabled women regardless of obesity status.

A significant association between previous history of breast cancer and mammography utilization among disabled and nondisabled women does exist ($X^2 = 20.72$; $p < .0001$). Although the analysis was limited to 830 women, women with a previous history of breast cancer demonstrated higher mammography rates than women who did not have a previous history of breast cancer. For example, 73.20% of disabled women with a history of breast cancer underwent mammography in the previous year as compared to 43.94% of disabled women with no previous history of breast cancer ($z = 329.77$; $p = .00$) (see Appendix B). However, the difference in mammography rates among nondisabled women based on a previous history of breast cancer was not as large. Notable are the similar mammography utilization rates among disabled and nondisabled women who had a previous history of breast cancer (73.20% vs. 73.10%, respectively). Thus, it appears that a previous history of breast cancer may exert a slightly stronger influence upon disabled women than upon nondisabled women.

Last in the results from Table 14, an association between level of comorbid conditions and mammography utilization in the previous year exists among disabled and nondisabled women ($X^2 = 11.53$; $p < .01$). Nondisabled women with the highest level of

comorbid conditions (i.e., 3-4 conditions) had a significantly lower rate of utilization (41.57%) than do women with 0 comorbid conditions (55.57%) ($z = 182.84$; $p = .00$) (see Appendix B for results of statistical testing). Among disabled women, however, mammography utilization rates were similar when comparing the different levels of comorbidity; utilization rates range from 41.96% to 43.40%.

Disability-Multivariate Analysis

Considering the various factors and characteristics that may influence a woman's utilization of mammography, logistic regression was used to explore the simultaneous impact of the various factors and characteristics (i.e., environment, population factors, health behaviors, and health outcomes) on the utilization of mammography. The independent variables were evaluated for multicollinearity via statistical analysis of correlation coefficients and beta coefficients. Upon examination, most variables used in this study had low Pearson correlation coefficients (see Appendix C for correlation coefficients). Those with higher correlation coefficients (i.e., WORKLIM*IADL = .467) were maintained due to their appropriateness given prior analyses (Hosmer & Lemeshow, 1989).

The analysis of beta coefficients was accomplished by adding independent variables one at a time to the logistic regression equation (Hosmer & Lemeshow, 1989). No substantial changes in beta coefficients were found as a result of adding individual independent variables. Based on analysis of Pearson correlation and beta coefficients, it is concluded that the independent variables are not collinear. Therefore, all independent

variables were included in the logistic regression model except for history of breast cancer dye to a large amount of missing data.

Multiple logistic regression equations were analyzed. First, the following logistic equation was analyzed:

mammography utilization = f (β0 + β1 ADL + β2 IADL + β3 cognitive limitation + β4 work limitation + β5 region + β6 MSA residency + β7 age + β8 race + β9 education + β10 income + β11 significant other + β12 health insurance + β13 smoking status + β14 previous CBE + β15 usual source of care + β16 barriers to health care use + β17 volume of health care use + β18 obesity + β19 other comorbid conditions).

Table 15 shows the results of the first binary logistic regression analysis to examine the simultaneous influence of the various factors on the utilization of mammography in the previous year without the inclusion of interaction among variables. A –2 Log Likelihood ratio of 3510.61 ($\underline{df} = 29$; $\underline{p} = .00$) indicates that the model fits the data. The $\underline{R}^2$ of .4401 indicates that some variance remains unaccounted for using the current model. Nonetheless, the model reveals valuable information regarding the factors that influence mammography utilization among disabled and nondisabled women.

In simultaneous examination of the factors influencing mammography utilization, only one disability type had a significant influence upon mammography utilization. Women having cognitive limitations are 34% less likely to report mammography in the previous year as compared to noncognitively disabled women (AOR = 0.66; 95% CI: 0.45, 0.97), after controlling for other factors. Other disabilities such as ADL, IADL, or work limitations were not statistically significant. Overall, environmental factors such as

Table 15

Likelihood of Mammography Utilization by Study Variables

Variable	Wald F	Adjusted Odds Ratio[a]	95% Confidence Interval
Disability			
Activities of daily living	0.74	0.81	0.50, 1.31
Instrumental activities of daily living	1.67	0.79	0.56, 1.13
Cognitive limitation	4.60*	0.66	0.45, 0.97
Work limitation	2.03	0.79	0.57, 1.09
Environmental factors			
Region	2.10		
Northeast		0.79	0.62, 0.99
Midwest		0.83	0.67, 1.03
South[b]		1.00	1.00, 1.00
West		0.99	0.78, 1.26
MSA-designated locale	1.32		
Yes[b]		1.00	1.00, 1.00
No		0.89	0.73, 1.09
Population characteristics			
Age (years)	7.50**		
50-59[b]		1.00	1.00, 1.00
60-69		1.04	0.83, 1.30
70-79		0.91	0.65, 1.27
≥ 80		0.49	0.33, 0.72
Race/ethnicity	2.67*		
Hispanic		1.36	0.98, 1.90
Caucasian[b]		1.00	1.00, 1.00
African-American		0.88	0.67, 1.16
Other		0.64	0.37, 1.10

Table 15 (continued)

Variable	Wald F	Adjusted Odds Ratio[a]	95% Confidence Interval
Educational level	8.96**		
≥High school		1.40	1.12, 1.74
< High school[b]		1.00	1.00, 1.00
Income (annual household)	0.13		
≥$20,000		1.04	0.84, 1.30
< 20,000[b]		1.00	1.00, 1.00
Significant other	0.02		
Yes		1.01	0.84, 1.21
No[b]		1.00	1.00, 1.00
Health insurance	3.25*		
No insurance[b]		1.00	1.00, 1.00
Private only		1.80	1.17, 2.77
Public only		1.31	0.82, 2.08
Private and public		1.46	0.92, 2.32
Health behaviors			
Smoking status	17.78**		
Yes		0.62	0.49, 0.77
No[b]		1.00	1.00, 1.00
Clinical breast exam (previous year)	1386.20**		
Yes		38.96	32.11, 47.28
No[b]		1.00	1.00, 1.00
Usual source of care	8.24**		
Yes		1.72	1.19, 2.50
No[b]		1.00	1.00, 1.00

Table 15 (continued)

Variable	Wald F	Adjusted Odds Ratio[a]	95% Confidence Interval
Barriers to health care use	2.12		
0[b]		1.00	1.00, 1.00
1-2		0.85	0.66, 1.12
3-5		2.38	0.72, 7.86
Volume of health care use	0.99		
≥ 10 visits		1.00	1.00, 1.00
< 10 visits[b]		1.13	0.89, 1.44
Health outcomes			
Obese	0.39		
Yes		0.94	0.77, 1.14
No[b]		1.00	1.00, 1.00
Comorbid conditions	2.24		
0[b]		1.00	1.00, 1.00
1-2		1.22	1.01, 1.49
3-4		0.95	0.58, 1.56

–2 Log L Ratio = 3510.61. p = .00. R^2 = 4401. df = 29.

[a]Adjusted for other variables.

[b]Reference category.

*p≤ .05. **p< .0001.

region of residence and residence in a MSA were not significant influences upon a woman's utilization of mammography in the previous year ($\alpha = .05$), after controlling for other factors. However, women residing in the Northeast were less likely to have undergone mammography in the previous year as compared to those in the South, the reference group (AOR = 0.79; 95% CI: 0.62, 0.99).

Particular population characteristic variables--or various levels thereof-- are also associated with the utilization of mammography. Age has a significant influence upon a woman's use of mammography (Wald $F = 7.50$; $p = .00$), specifically among women ages $\geq$ 80 years. Women $\geq$ 80 years were half as likely to have undergone mammography in the previous year as compared to women ages 50 –59 years (AOR = 0.49; 95% CI: 0.33, 0.72). Overall, older women (i.e., $\geq$ 70 years) tend to report lower mammography utilization than do women < 69 years.

Race also had a significant influence upon mammography utilization (Wald $F = 2.67$; $p \leq .05$). African American and other nonHispanic minorities are less likely to have undergone mammography in the previous year as compared to Caucasian women, although the results were not statistically significant (AOR = 0.88; 95% CI: 0.67, 1.16 and AOR = 0.64; 95% CI: 0.37, 1.10, respectively). However, notable though not statistically significant, is the finding that Hispanic women were more likely to report mammography in the previous year as compared to Caucasian women (AOR = 1.36; 95% CI: 0.98, 1.90).

Neither annual household income nor the presence of a significant other were statistically significant influences upon mammography use when controlling for other

factors (Wald F = 0.13; p = .71 and Wald F = 0.02; p = .90, respectively). However, education was a significant influence upon mammography utilization (Wald F = 8.96; p = .00), after controlling for other variables. Women who had a high school education or higher were more likely to have undergone mammography in the previous year than women with less than a high school education (AOR =1.40; 95% CI: 1.12, 1.74). Likewise, the type of insurance was associated with mammography utilization in the previous year (Wald F = 3.25; p = .02). Most significantly, women with private health insurance were nearly two times more likely to have undergone mammography than the reference group (i.e., no health insurance) (AOR = 1.80; 95% CI: 1.17, 2.77). Though women with public health insurance and combinations of public and private health insurance may be more likely to have undergone mammography in the previous year as compared to women lacking health insurance, this was not statistically significant.

Several variables for examining health behavior were found to significantly influence mammography utilization after controlling for other variables. Women who were self-reported smokers were less likely to have undergone mammography in the previous year as compared to nonsmokers (AOR = 0.62; 95% CI: 0.49, 0.77).

A particularly significant finding was the strong association of CBE and mammography in the previous year (Wald F = 1386.20; p = .00). Women who had a CBE in the previous year were almost 39 times more likely to have had a mammogram in the previous year as compared to those who did not have a CBE (AOR = 38.96; 95% CI: 32.11, 47.28).

An association between a usual source of health care and mammography utilization was found (Wald F = 8.24; p = .00). Women with a usual source of care were nearly two times more likely to utilize mammography after controlling for other factors (AOR = 1.72; 95% CI: 1.19, 2.50). However, despite the strong association of certain health behaviors and mammography utilization, other health behavior variables were not significant according to the logistic regression analysis. No significant findings were found between the use of mammography in the previous year and barriers to health care use. Likewise, an association between mammography and volume of health care use was not found.

Last, health outcome variables were not associated with mammography utilization after controlling for other factors. The number of comorbid conditions as well as obesity status were not statistically significant variables.

A second equation evaluates the influence of a previous history of breast cancer upon mammography utilization. Data for 830 women for whom breast cancer data were available were included in this analysis. The logistic regression equation was:

mammography utilization = f (β0 + β1 ADL + β2 IADL + β3 cognitive limitation + β4 work limitation + β5 region + β6 MSA residency + β7 age + β8 race + β9 education + β10 income + β11 significant other + β12 health insurance + β13 smoking status + β14 previous CBE + β15 usual source of care + β16 barriers to health care use + β17 volume of health care use + β18 obesity + β19 other comorbid condition + β20 previously diagnosed breast cancer).

The statistically significant variables from the logistic regression analysis of the sample population for whom breast cancer history information was available (n = 830) are reported in Table 16. A –2 Log Likelihood ratio of 483.03 (df = 30; p = .00) indicates that the model fits the data. The R^2 of .4412 indicates little improvement over the first model. Much variance remains unaccounted for using the model that includes the breast cancer variable. Nonetheless, the model reveals valuable information regarding the factors that influence mammography utilization among disabled and nondisabled women.

In the sub-analysis, the disability measures IADL and cognitive limitations, race/ethnicity, health insurance, use of CBE, and previous history of breast cancer variables were statistically significant ($\alpha = .05$). Age, smoking status, education, and usual source of care variables were not statistically significant variables for this sample population. A history of breast cancer was associated with the use of mammography in the previous year (Wald F = 8.15; p = .00). Women with a history of breast cancer were twice as likely to have undergone mammography in the previous year (AOR = 2.01; 95% CI: 1.24, 3.25) as compared to women who did not have a diagnosis of previous breast cancer.

Table 17 reports the Wald F statistics for the statistically significant interaction terms based on the following logistic regression equation:

mammography utilization = f (β0 + β1 ADL + β2 IADL + β3 cognitive limitation + β4 work limitation + β5 region + β6 MSA residency + β7 age + β8 race + β9 education + β10 income + β11 significant other + β12 health insurance + β13 smoking status + β14 previous CBE + β15 usual source of care + β16 barriers to health care use + β17

Table 16

Likelihood of Mammography Utilization for Sub-Sample[a] -Significant Results (n = 830)

Variable	Wald F	Adjusted Odds Ratio[b]	95% Confidence Interval
Disability			
IADL	4.48*	0.49	0.25, 0.95
Cognitive	4.99*	0.34	0.13, 0.88
Population characteristics			
Health insurance	3.75**		
No insurance[c]		1.00	1.00, 1.00
Private only		2.24	0.62, 8.15
Public only		0.82	0.20, 3.39
Private and public		0.56	0.13, 2.44
Race/ethnicity	2.59*		
Hispanic		3.60	1.15, 11.25
Caucasian		1.00	1.00, 1.00
African-American		2.87	1.06, 7.75
Other		1.06	0.14, 7.83
Health behaviors			
Clinical breast exam (previous year)	185.75***		
Yes		50.19	28.52, 88.33
No[c]		1.00	1.00, 1.00
Health outcomes			
Previous history of breast cancer	8.15***		
Yes		2.01	1.24, 3.25
No[c]		1.00	1.00, 1.00

–2 Log L Ratio = 483.03. $p = .00$. $R^2 = .4412$. $df = 30$.

[a] Sample (n = 830) restricted to those respondents for whom breast cancer history was available.

[b] Adjusted for other variables.

[c] Reference category.

*$p \leq .05$. ** $p < .01$ ***$p < .0001$.

Table 17

Statistically Significant Interaction Terms ($p < .05$)

Interaction	Wald F
IADL*Age	2.29*
IADL*Insurance	2.39*

Note: -2 Log L Ratio = 3563.73. $p = .00$. $R^2 = .4450$. $df = 71$.
*$p \leq .05$.

*volume of health care use + β18 obesity + β19 other comorbid conditions + β20 previous history of breast cancer + β21ADL * age + β22 ADL*race + β23 ADL*income + β24 ADL*health insurance + β25 IADL* age + β26 IADL*race + β27 IADL*income + β28 IADL*health insurance+ β29 cognitive limitation* age + β30 cogntive limitation*race + β31 cognitive limitation*income + β32 cognitive limitation*health insurance+ β33 work limitation* age + β34 work limitation*race + β35 work limitation*income + β36 work limitation*health insurance).*

Specifically, interactions between all four disability measures (i.e., presence of ADL, IADL, cognitive limitation, work limitation) were crossed by the following factors: age, race, income, and type of insurance. These factors were chosen due to their potential for interaction based on the review of the literature (Bradsher, 1996; Kelaher & Stellman, 2000; ; Kennedy & LaPlante, 1997; LaPlante, Rice, & Kraus, 1991; McNeil, 1997; Wilcox-Gök, 2000).

Based on the $R^2 = .4450$, the inclusion of interaction terms did not improve greatly upon the first logistic regression model. However, results do indicate that certain interactions between disability measures and select characteristics of the population are significant. The interaction between IADL*Age occurred among women reporting IADL who were ages 70-79 years and ≥80 years. Women with IADLs ages 70-79 years were less likely to utilize mammography (AOR = 0.20; 95% CI: 0.05, 0.85). Likewise, women with IADLs ≥80 years were also less likely to utilize mammography (AOR = 0.16; 95% CI: 0.03, 0.74). The interaction between IADL*Insurance occurred among women with IADL who had private health insurance. These women were less likely to utilize

mammography (AOR = 0.16; 95% CI: 0.03, 1.00). However, this association should be considered weak since the upper 95% OR limit is 1.00.

Hypothesis Testing

The following section discusses the results of statistical testing for the hypotheses testing of the hypotheses presented previously in Chapters 2 and 3. Table 18 summarizes the statistical testing of hypotheses.

Environmental Hypotheses

The first set of hypotheses (i.e., H1A, H1B, and H1C) explore the influence of environmental factors, such as geographic region and residence, on the utilization of mammography among disabled and nondisabled women in the U.S.

H1A. No statistically significant differences exist in mammography rates for disabled women (i.e., presence of any ADL, IADL, cognitive, and/or work limitation [s]) residing in non-MSA locales compared to nondisabled women residing in non-MSA locales.

Approximately one-quarter (23.46%) of the study population resided in non-MSA designated locales (see Table 12). Furthermore, a greater proportion of disabled women resided in non-MSA designated locales (28.10%) than did their nondisabled cohorts (22.29%). Mammography utilization rates vary among disabled and nondisabled women who resided in non-MSA locales. Among non-MSA residents, only 40.12% of disabled women utilized mammography in the previous year as compared to 51.74% of nondisabled women ($z = 271.34$; $p = .00$) (see Appendix B for results of statistical testing). Based on these results, the null hypothesis for H1A is not supported; statistically

Table 18

Summary of Study Hypotheses and Results of Statistical Testing

Hypothesis	Null Hypothesis Supported?
H1A. No statistically significant differences exist in mammography rates for disabled women (i.e., presence of any ADL, IADL, cognitive, and/or work limitation [s]) residing in non-MSA locales compared to nondisabled women residing in non-MSA locales.	No
H1B. No statistically significant differences exist in mammography rates for disabled women residing in MSA-designated locales compared to nondisabled women residing in MSA-designated locales.	No
H1C. No statistically significant differences exist in mammography rates for women with disabilities (i.e., presence of any ADL, IADL, cognitive, and/or work limitation [s]) and nondisabled women across regions of the U.S.	Yes
H2A. No statistically significant differences exist in mammography rates for nondisabled Caucasian women as compared to nondisabled minority women.	No
H2B. No statistically significant differences exist in mammography rates for disabled Caucasian women (i.e., presence of any ADL, IADL, cognitive, and/or work limitation [s])as compared to disabled minority women.	Yes

Table 18 (continued)

Hypothesis	Null Hypothesis Supported?
H2C. No statistically significant differences exist in mammography rates for women with functional limitations (i.e., ADL and/or IADL limitation [s]) as compared to women with other limitations (i.e., cognitive and/or work limitation [s]).	No
H2D. No statistically significant differences exist in mammography rates for women with and without cognitive limitations.	No
H2E. No statistically significant differences exists in mammography rates among lower-income (i.e., < $20,000 annual household income) disabled women compared to low-income nondisabled women.	No
H2F. No statistically significant differences exists in mammography rates among higher-income (i.e., ≥ $20,000 annual household income) disabled women compared to higher-income nondisabled women.	No
H2G. No statistically significant differences exists in mammography rates among disabled and nondisabled women according to type of health insurance.	No
H3A. No statistically significant differences exist in mammography utilization rates among disabled and nondisabled women according to smoking status.	No

Table 18 (continued)

Hypothesis	Null Hypothesis Supported?
H3B. No statistically significant differences exist in mammography utilization rates among disabled and nondisabled women according to CBE utilization in the previous year.	No
H4A. No statistically significant differences exist in mammography rates among obese, disabled women as compared to obese, nondisabled women.	No
H4B. No statistically significant differences exist in mammography rates among nonobese disabled women as compared to non-obese, nondisabled women.	No
H4C. No statistically significant differences exist in mammography rates among disabled and nondisabled women by level of comorbid conditions (i.e., hypertension, coronary artery disease, myocardial infarction, or stroke).	No
H5. Mammography utilization is not influenced by the presence of various disability measures, after controlling for environmental, population characteristics, health behaviors, and health outcomes.	Mixed

significant differences do exist in mammography rates for disabled women residing in non-MSA locales compared to nondisabled women residing in non-MSA locales.

H1B. No statistically significant differences exist in mammography rates for disabled women residing in MSA-designated locales compared to nondisabled women residing in MSA-designated locales.

Approximately three-quarters (76.54%) of the study population lived in MSA-designated locales. However, a smaller proportion of disabled women resided in MSA-designated locales as compared to nondisabled women (71.90% vs. 77.71%, respectively). Analysis of disabled and nondisabled women residing in MSA-designated locales indicate that significant differences in the mammography utilization rates among the two groups does exist. As indicated previously in Table 14, only 44.11% of disabled women in MSA-designated locales utilized mammography in the previous year as compared to 58.98% of nondisabled women residing in MSA-designated locales (z = 570.65; p = .00) (see Appendix B). Thus, the results do not support the null hypothesis. Statistically significant differences do exist in mammography rates for disabled women residing in MSA-designated locales compared to nondisabled women residing in MSA-designated locales.

H1C. No statistically significant differences exist in mammography rates for women with disabilities (i.e., presence of any ADL, IADL, cognitive, and/or work limitation [s]) and nondisabled women across regions of the U.S.

Mammography utilization rates among disabled and nondisabled women in the four regions of the U.S. (i.e., Northeast, Midwest, South, and West) varied. However, the

association across region and mammography utilization was not significant (see Table 14). Nonetheless, mammography utilization rates were significantly lower for disabled women as compared to nondisabled women within each region. For example, in the Northeast, the utilization rate for disabled women was 46.06% while the proportion of nondisabled women in the Northeast who utilized mammography in the previous year was 61.03% ($z = 291.38$; $p = .00$) (see Appendix B for results of statistical testing). The greatest disparity in mammography rates among disabled and nondisabled women was found in the West. The proportion of disabled women residing in the West who utilized mammography in the previous year was 39.49% as compared to 57.17% of the nondisabled population ($z = 357.47$; $p = .00$) (see Appendix B). Results indicate that statistically significant differences do not exist in mammography rates for women with disabilities compared to nondisabled women across regions of the U.S. Thus, the null hypothesis for H1C is supported.

Population Characteristics Hypotheses

The hypotheses H2A through H2F explore the association of various population factors (e.g., age, race/ethnicity, income, etc.) and the utilization of mammography among disabled and nondisabled women in the U.S.

H2A. No statistically significant differences exist in mammography rates for disabled (i.e., presence of any ADL, IADL, cognitive, and/or work limitation) Caucasian women as compared to nondisabled minority women.

Caucasian women comprised the vast majority of the nondisabled cohort (83.19%). Furthermore, Caucasian women had higher utilization rates than other

nondisabled women across racial/ethnic groups examined in this study. Among nondisabled women, approximately 59% of nondisabled Caucasian women utilized mammography in the previous year as compared to 52.99% for African-Americans, 50.77% among Hispanics, and 44.52% among other racial/ethnic groups ($X^2 = 15.28$; $p < .01$) (see Appendix B for results of statistical testing). Thus, H2A is not supported as statistically significant differences do exist in mammography rates for nondisabled Caucasian women as compared to nondisabled minority women.

H2B. No statistically significant differences exist in mammography rates for disabled Caucasian women as compared to disabled minority women.

Similar to the racial/ethnic characteristics of the nondisabled population discussed previously, Caucasian women also comprised the majority of the disabled cohort in this study (77.42%) (see Table 13). Among the disabled population, however, African-American women demonstrated the highest rate of mammography utilization at 47.67% (see Table 14). Only 42.54% of disabled Caucasian women utilized mammography in the previous year and are ranked as third among the four racial/ethnic categories in this study. Disabled women in the 'other' category reported the lowest rate of mammography utilization; only 23.26% reported the utilization of mammography in the previous year. Based on the analysis of mammography utilization rates among disabled Caucasian, Hispanic, African-American and other race/ethnicity groups, no statistically significant differences exist in mammography rates for disabled Caucasian women as compared to disabled minority women ($X^2 = 4.98$; $p = .18$) (see Appendix B). Thus, H2B is supported.

H2C. No statistically significant differences exist in mammography rates for women with and without cognitive limitations.

To explore H2C, mammography rates for the 4.76% of the sample population with self-reported cognitive limitations were compared to those women without cognitive limitation. For this hypothesis, women with other reported limitations (i.e., ADL, IADL, and work limitations) were classified as 'without' cognitive limitations. The cognitively disabled population varied significantly from the noncognitively disabled population (see Appendix D for comparison of the cognitively versus noncognitively disabled study populations).

Only 34.36% of women with cognitive limitations utilized mammography in the previous year as compared to 55.49% of the noncognitively disabled population ($\underline{z}$ = 525.49; $\underline{p}$ = .00) (see Appendix B). Based on these results, H2C is <u>not</u> supported. Significant differences in mammography rates <u>do</u> exist among women with and without cognitive limitations.

H2D. No statistically significant differences exists in mammography rates among lower income (i.e., < $20,000 annual household income) disabled women compared to lower income nondisabled women.

Only 38.17% of disabled women with annual household incomes < $20,000 utilized mammography in the previous year as compared to 45.28% of nondisabled women of the same income level. Comparison of mammography utilization between lower-income disabled and nondisabled women indicates that statistically significant

differences did exist in utilization rates ($z = 220.99$; $p = .00$) (see Appendix B for results of statistical testing). Thus, H2D is not supported.

H2E. No statistically significant differences exists in mammography rates among higher income (i.e., > $20,000 annual household income) disabled women compared to higher income nondisabled women.

Among women with higher levels of income, disabled women demonstrated lower mammography rates than their nondisabled cohort. Approximately one-half (49.67%) of higher income disabled women utilized mammography in the previous year compared to 61.72% of higher income, nondisabled women ($z = 364.58$; $p = .00$) (see Appendix B). Thus, significant differences do exist in mammography rates among higher income disabled and nondisabled women. H2E is not supported.

H2F. No statistically significant differences exist in mammography rates among disabled and nondisabled women according to type of health insurance.

As discussed previously, an association between health insurance and mammography utilization exists ($X^2 = 175.70$; $p < .0001$). Noted are the higher rates of mammography utilization among nondisabled women for most health insurance groups (see Table 14). For example, a slightly greater proportion of nondisabled women with only a private source of insurance utilized mammography in the previous year as compared to their disabled cohort ($z = 12.71$; $p = .00$) (see Appendix B for results of statistical testing). In comparing utilization rates between disabled and nondisabled women for all four health insurance groups, results indicate that nondisabled women had higher mammography utilization rates than do disabled women for all health insurance

types (probabilities = .00). Therefore, the significant differences in mammography utilization rates among disabled and nondisabled women do not support H2F.

Health Behaviors Hypotheses

The individual hypotheses of H3 explore the utilization rates of disabled versus nondisabled women according to specific health behaviors. Comparison of utilization rates between disabled and nondisabled women based on smoking status and utilization of CBE in the previous year indicates if those who engage in positive and preventive health practices utilize mammography at higher rates than those who do not engage in such practices.

H3A. No statistically significant differences exist in mammography utilization rates among disabled and nondisabled women according to smoking status.

Although a larger proportion of disabled women smoke (19.52%) as compared to nondisabled women (16.30%) (see Table 13), disabled smokers reported mammography utilization rates that were lower than nondisabled smokers. As indicated in Table 14, only 40.66% of disabled smokers utilized mammography in the previous year as compared to 45.02% of nondisabled smokers ($z = 85.34$; $p = .00$) (see Appendix B for results of statistical testing). The results were statistically significant indicating that H3A is not supported. Mammography utilization in the previous year is lower among disabled smokers and nonsmokers as compared to their respective nondisabled cohort.

H3B. No statistically significant differences exist in mammography utilization rates among disabled and nondisabled women according to CBE utilization in the previous year.

A smaller proportion of disabled women who underwent a CBE in the previous year utilized mammography as compared to nondisabled women (73.15% vs. 83.51%; z = 400.31; p = .00) (see Table 14 and Appendix B for statistical testing results). Notable is that disabled and nondisabled women who reported having a CBE in the previous year demonstrated the highest utilization rates as compared to other study factors/characteristics examined in this study except for those women with a previous diagnosis of breast cancer. Based on the differences in mammography utilization rates, H3B is not supported because statistically significant differences do exist in mammography utilization rates between disabled and nondisabled women according to CBE utilization.

Health Outcomes Hypotheses

The fourth set of hypotheses evaluated the influence of the outcomes of health behavior and health care upon mammography use among disabled and nondisabled women.

H4A. No statistically significant differences exist in mammography rates among obese disabled women as compared to obese nondisabled women.

A greater proportion of disabled women were obese (30.40%) compared to nondisabled women (24.16%) (z= 306.12; p = .00) (see Appendix B for results of statistical testing). Furthermore, obese disabled women demonstrated lower rates of mammography utilization in the previous year (48.66%) than did obese nondisabled women (58.42%; z = 234.36; p = .00) (see Appendix B). Thus, H4A is not supported;

statistically significant differences do exist in mammography rates among obese disabled women as compared to obese nondisabled women.

H4B. No statistically significant differences exist in mammography rates among nonobese disabled women as compared to nonobese, nondisabled women.

Results comparing mammography utilization rates for nonobese disabled and nondisabled women were similar to those presented previously for H4A. A greater proportion of nondisabled women were not obese (75.84%) as compared to disabled women (69.60%) ($z = 306.12$; $p = .00$) (see Table 13 for data and Appendix B).

Regarding mammography utilization among nonobese women, a smaller proportion of disabled women utilized mammography in the previous year (40.51%) than did the nondisabled cohort (57.03%) ($z = 187.89$; $p = .00$) (see Appendix C for statistical testing results). Thus, the statistically significant difference in mammography rates among nonobese disabled women as compared to nonobese, nondisabled women does not support H4B.

H4C. No statistically significant differences exist in mammography rates among disabled and nondisabled women by level of comorbid conditions (i.e., hypertension, coronary artery disease, myocardial infarction, or stroke).

As noted in Table 13, disabled women reported more comorbid conditions than did nondisabled women. For example, 8.90% disabled women had 3-4 comorbid conditions compared to 1.73% of nondisabled women ($z = 611.12$; $p = .00$) (see Appendix B). Analysis of mammography utilization rates among disabled and

nondisabled women revealed that the proportion of disabled women utilizing mammography is similar regardless of the level of comorbid conditions (see Table 14).

Disabled women with 0 or 1-2 comorbid conditions had lower utilization rates as compared to their nondisabled cohort. For example, 42.64% of disabled women with 0 comorbid conditions utilized mammography in the previous year as compared to 55.57% of nondisabled women ($z = 331.55$ $p = .00$) (see Appendix B). Approximately 43% of disabled women with 1-2 comorbid conditions utilized mammography in the previous year as compared to 60% of nondisabled women ($z = 580.63$; $p = .00$) (see Appendix B). The utilization rate among disabled women with 3-4 comorbid conditions, although similar, was significantly greater (41.96%) than the utilization rate among the nondisabled cohort due to the large sample size (41.57%) ($z = 3.86$; $p = .00$) (see Appendix B). Based on the statistically significant differences in mammography utilization rates among all levels of comorbid conditions, the conclusion is that H4C is not supported.

Disability Hypothesis

The disability hypotheses sought to determine the influence of various disability variables upon mammography utilization after controlling for other factors. First, the following regression model was evaluated to determine if the various disability variables remained significant:

$$\textit{mammography utilization} = f(\beta 0 + \beta 1\ \textit{ADL} + \beta 2\ \textit{IADL} + \beta 3\ \textit{cognitive limitation} + \beta 4\ \textit{work limitation} + \beta 5\ \textit{region} + \beta 6\ \textit{MSA residency} + \beta 7\ \textit{age} + \beta 8\ \textit{race} + \beta 9\ \textit{education} + \beta 10\ \textit{income} + \beta 11\ \textit{significant other} + \beta 12\ \textit{health insurance} + \beta 13\ \textit{smoking status} + \beta 14$$

previous CBE + β15 usual source of care + β16 barriers to health care use + β17 volume of health care use + β18 obesity + β19 other comorbid conditions).

Based on the results of the logistic regression model, evidence indicates that the presence of only particular disability measures may be associated with mammography utilization. Among the study sample, only cognitive limitation was a statistically significant disability variable (see Table 15). Women with cognitive limitations were half as likely to utilize mammography in the previous year, after controlling for other factors.

In addition, the influence of specified interactions were evaluated using the previous regression model. This model was:

*mammography utilization = f (β0 + β1 ADL + β2 IADL + β3 cognitive limitation + β4 work limitation + β5 region + β6 MSA residency + β7 age + β8 race + β9 education + β10 income + β11 significant other + β12 health insurance + β13 smoking status + β14 previous CBE + β15 usual source of care + β16 barriers to health care use + β17 volume of health care use + β18 obesity + β19 other comorbid conditions + β20 previous history of breast cancer + β21ADL * age + β22 ADL*race + β23 ADL*income + β24 ADL*health insurance + β25 IADL* age + β26 IADL*race + β27 IADL*income + β28 IADL*health insurance+ β29 cognitive limitation* age + β30 cogntive limitation*race + β31 cognitive limitation*income + β32 cognitive limitation*health insurance+ β33 work limitation* age + β34 work limitation*race + β35 work limitation*income + β36 work limitation*health insurance).*

Results indicate that the addition of the interaction terms did not improve the model. However, interactions at the $\alpha = .05$ level were found between IADL*Age and IADL*Insurance.

Last, the influence of a previous diagnosis of breast cancer was evaluated. The regression model was:

mammography utilization = f (β0 + β1 ADL + β2 IADL + β3 cognitive limitation + β4 work limitation + β5 region + β6 MSA residency + β7 age + β8 race + β9 education + β10 income + β11 significant other + β12 health insurance + β13 smoking status + β14 previous CBE + β15 usual source of care + β16 barriers to health care use + β17 volume of health care use + β18 obesity + β19 other comorbid conditions + β20 previous history of breast cancer).

Among the sub-sample of 830 women for whom breast cancer data were available, those with cognitive and IADL were less likely to utilize mammography, after controlling for other factors (see Table 16).

Based on these results, the support for H5 is mixed. Mammography utilization is influenced by the presence of particular disabilities (i.e., primarily cognitive limitations in this analysis), after controlling for environmental, population characteristics, health behaviors, and health outcomes. Interestingly, ADL and IADLs did not significantly influence mammography utilization after controlling for other factors.

Summary of Results

In this study, data for women ≥ 50 years having nonmissing data in the 1998 NHIS PREVADLT file were analyzed. The disabled and nondisabled populations

differed significantly by many of the environmental, population characteristics, health behaviors, and health outcomes variables examined in this study. The proportion of disabled and nondisabled women reporting mammography in the previous year varied, although the rate for disabled women (regardless of the type of limitation/disability) was consistently lower than the rate for nondisabled women. Analysis of mammography rates indicated statistically significant differences between the disabled and nondisabled populations for the majority of variables.

When mammography utilization in the previous year was adjusted for other factors, however, only particular population characteristics and health behaviors had a significant effect. Population characteristics that had a significant influence included disability status, age, race/ethnicity, education level, and type of insurance. Health behaviors that had significant effects included the use of clinical breast exam in the previous year and having a usual source of health care. Environmental factors and outcomes of health care did not significantly affect mammography utilization in the previous year. Among the four disability measures, only cognitive limitations were significantly associated with mammography use in the previous year in the regression model that controlled for other factors. Results of statistical testing of the study hypotheses were summarized in Table 18. The next chapter discusses these findings including the implications and limitations of the study.

CHAPTER 5: DISCUSSION

This final chapter discusses the results reported in Chapter 4 in relation to the literature, hypotheses, and methodology. Results are summarized and discussed in three sections: significant influences/effects, nonsignificant influences/effects, and unmeasured influences (limitations). Conclusions, implications, and recommendations are identified for practice, health policy, and future research.

Summary

This retrospective, ex post facto study examined the factors that influence the utilization of mammography among disabled and nondisabled women ≥ 50 years. This study differed from previous research due to several methodological reasons. Previous research has focused primarily on women ≥ 65 years. This study expands the age ranges to include women ≥ 50 years so that conclusions could be drawn for a larger population. Furthermore, a broad definition of disability was employed that included traditional functional measures (i.e., ADL and IADL) as well as additional measures of disability such as cognitive and work limitations.

The inclusion of broad limitation measures, as well as variables derived from the health services utilization model, allowed for a more accurate determination of the factors, influences, and behaviors that influence mammography utilization by the disabled population. This was accomplished by the inclusion of variables that have been

demonstrated previously in the literature to influence mammography utilization. Previous studies using only functional limitation measures, nonrepresentative sample populations, and lack of control for confounding variables have led to varied results. Although the simultaneous influence of environmental, population characteristics, health behaviors, and health outcomes on the utilization of mammography in the previous year were assessed, it is recognized that other influential factors were not included in this study (i.e., physician recommendation, influence of media, etc.).

Significant Influences/Effects

Disabled women, defined as those reporting any ADL, IADL, cognitive and work limitation(s), differed from nondisabled women in this study. As compared to nondisabled women, significantly greater proportions of disabled women were (the constructs of the conceptual model measured by these variables are identified in parentheses):

- resident in non-MSA localities (environment),
- older (especially ≥ 80 years) (population characteristics),
- members of a racial/ethnic minority (i.e., African-American and Hispanic) (population characteristics),
- lacking a high school education (population characteristics),
- lower income (i.e., < $20,000 annual household income) (population characteristics),
- lacking a significant other (population characteristics),
- beneficiaries of public types of health insurance (e.g., Medicare, Medicaid, etc.) (population characteristics),

- smokers (health behaviors),
- less likely to report a CBE in the previous year (health behaviors),
- affected by more barriers to health care use (health behaviors),
- utilizers of higher volumes of health care (health behaviors),
- obese (health outcomes),
- affected by more comorbid conditions (health outcomes).

The majority of aforementioned factors were associated with underutilization of mammography in studies discussed in Chapter 2 and summarized in Table 9. Based on the lower education and income among the disabled sample, the results support Welner's (1998) claim that disabled women are disadvantaged socioeconomically. Thus, analysis of utilization rates and the factors associated with utilization in the previous year was necessary to ensure access to mammography is equitable.

Mammography rates among disabled and nondisabled women were examined, stratified by various environmental, population characteristics, health behaviors, and health outcome variables. The significantly lower mammography utilization rates in the previous year among disabled women as compared to nondisabled women were associated with the limited variables measuring the four constructs of the health services utilization model. They included:

- environmental factors (i.e., geographic region of residence, residence in MSA versus non-MSA designated locality),
- population characteristics (i.e., age, race/ethnicity, education level, income, presence/absence of significant other, type of health insurance),

- health behaviors (i.e., smoking status, utilization of CBE in the previous year, presence of usual source of care, barriers to health care use, volume of health care use),
- and health outcomes (i.e., previous history of breast cancer and presence/level of comorbid conditions).

Most notably, the proportion of disabled women who reported mammography in the previous year was much lower than for nondisabled women. This finding is consistent with the literature demonstrating that women with functional limitations rates (Blustein & Weiss, 1998; Chan et al., 1999; Iezzoni, McCarthy, Davis, & Siebens, 2000) and cognitive limitations (Ives, Lave, Traven, Schulz, & Kuller, 1996) report lower mammography utilization rates (Chan et al., 1999; Ives, Lave, Traven, Schulz, & Kuller, 1996). Disabled women may utilize mammography at lower rates due to a convergence of factors such as sociodemographic (e.g., race/ethnicity, income) (Bradsher, 1996; Kaye, 1997; NCHS, 1998; Kennedy & LaPlante, 1997; Kington & Smith, 1997; LaPlante & Carlson, 1996) and other barriers to health care use (e.g., transportation, physical access, comorbidities, lack of knowledge, lack of physician recommendation) (Blustein & Weiss, 1998; Davies & Duff, 2001; Hsia et al., 2000; Marwill, Freund, & Barry, 1996). Mammography utilization among disabled women was lower across all disability measures addressed in this study.

The lower rates of mammography utilization among disabled women as compared to nondisabled according to MSA residency were consistent with the findings of Horton, Cruess, and Romans (1996). Women in non-MSA localities demonstrated the lowest

rates of mammography utilization in the previous year, regardless of disability status. However, disabled women in non-MSA localities had the lowest mammography rates. This finding may be due to fewer health care facilities in non-MSA localities (Dowling, 1999; Ferris & Litaker, 1993; Liff et al., 1991) or the distance one has to travel to access health care facilities (Rowland & Lyons, 1989). Furthermore, disabled women may be particularly affected due to access issues (e.g., transportation, distance to facility) or accommodation issues (e.g., lack of wheelchair access, inability to assume position[s] for mammogram) (Kamm, 2000; Nosek & Howland, 1997).

Lower rates of mammography utilization according to various population characteristics are also consistent with literature cited previously, including (but not limited to) Blustein and Weiss (1998); Breen, Feuer, Depuy, and Zapka (1997); Calle, Flanders, Thun, and Martin (1993); Frazier, Jiles, and Mayberry (1996); Hedegaard, Davidson, and Wright (1996); Hsia et al. (2000); Lane, Caplan, and Grimson (1996); Marwill, Freund, & Barry, 1996; Phillips, Kerlikowske, Baker, Chang, and Brown (1998); Potosky, Breen, Graubard, and Parsons (1998). The proportion of women reporting mammography in the previous year steadily declined with advancing age among both disabled and nondisabled groups. However, the rates for disabled women were consistently lower than the rates of the nondisabled cohort for all age groups. Furthermore, the rate for older disabled women dropped considerably. Although mammography utilization has been demonstrated to decline with advancing age (Balducci & Phillips, 1998; Breen, Feuer, Depuy, & Zapka, 1997; Fox, Roetzheim, & Kingston, 1997; Halabi, Vogel, Bondy, & Vernon, 1993; Marwill, Freund, & Barry,

1996; Persky & Burack, 1997), mammography utilization among disabled women may be particularly affected. Physical and mental limitations/difficulties associated with the aging process may be further exacerbated in the disabled population. Thus, older disabled women may be at increased risk for not utilizing mammography.

Rates of mammography utilization stratified by race/ethnicity revealed interesting results. An association between race/ethnicity and mammography utilization has been demonstrated in the literature, particularly among racial/ethnic minorities (Bowen, Hickman, & Powers, 1997; Burns et al., 1996; Frazier, Jiles, & Mayberry, 1996; Hedegaard; Davidson, & Wright, 1996; Hoffman-Goetz & Mills, 1997; NCI Cancer Screening Consortium for Underserved Women, 1995; Rojas et al., 1996; Suarez, Roche, Nichols, & Simpson, 1997; Valdini & Cargill, 1997). Caucasian women consistently utilize mammography at higher rates than minority (i.e., non-Caucasian) women. The association between race/ethnicity and mammography demonstrated previously in the aforementioned literature was supported in this study. However, results in this study differed among the disabled population. Disabled women consistently reported lower utilization of mammography in the previous year for all race/ethnic groups, although a smaller proportion of disabled Caucasian women utilized mammography in the previous year as compared to disabled Hispanic and African-American women.

This finding may reflect the prevalence and impact of disability in various racial/ethnic groups. Because disabilities are more prevalent in racial/ethnic minority populations (Bradsher, 1996; Kennedy & LaPlante, 1997; LaPlante & Carlson, 1996), acceptance of, or adaptability to, disabling condition(s) may be more common among

these minority groups. Furthermore, programs to improve health care access for disabled women may target minority women at the expense of Caucasian women. Many interventions are discussed in the literature targeting particular racial/ethnic minorities in the effort to improve minority utilization as compared to Caucasians (Eng, 1993; Fox, Stein, Gonzalez, Farrenkopf, & Dellinger, 1998; Gill & McClellan, 1998; Suarez et al., 1997).

Lower rates of mammography were found among both disabled and nondisabled women with less than a high school education. However, the largest difference in mammography rates among women with a high school education or greater as compared to women with less than a high school education was found among nondisabled women. This result may be associated with the larger proportion (79.03%) of nondisabled women with a high school education or greater. Conversely, almost one-half of the disabled population had less than a high school education. Moreover, the lowest rate of mammography utilization in the previous year was found among disabled women with less than a high school education. Disabled women may be more prone not to utilize mammography due to decreased knowledge of preventive health measures and benefits of health care based on Grossman's (1972 a, b) hypothesis that those persons with higher education are better consumers of healthcare.

Similar to the literature demonstrating lower mammography use among lower income women (Breen & Kessler, 1994; Calle, Flanders, Thun, & Martin, 1993; Hsia et al., 2000; NCI Cancer Screening Consortium for Underserved Women, 1995), women in the lower annual household income group (i.e., < $20,000 annual household income) had

lower mammography utilization rates regardless of disability status. Furthermore, disabled women had the lowest utilization rates when examining mammography use by income. Lower income women, especially the disabled, may be limited in their access to health insurance (Master & Taniguchi, 1996; Wilcox-Gök, 2000). Consequently, they may be subject to higher out-of-pocket expenses and health care costs (Max, Rice, & Trupin, 1995).

The association between a reported significant other and mammography utilization was consistent with previous literature (Ives, Lave, Traven, Schulz, & Kuller, 1996; Maxwell, Kozak, Desjardins-Denault, & Parboosingh, 1997) for both the disabled and nondisabled cohort. Among disabled and non–disabled groups, women with a significant other had the highest rates of mammography utilization. Although a minority of disabled women reported a significant other (i.e., approximately 40%), they continued to utilize mammography at higher rates than did disabled women without a significant other. This finding is similar to previous studies (Ives, Lave, Traven, Schulz, & Kuller, 1996; Maxwell, Kozak, Desjardins-Denault, & Parboosingh, 1997). The low rate of mammography utilization among disabled women lacking a significant other may reflect the lack of social support among a group already vulnerable to underutilization of mammography (Ives, Lave, Traven, Schulz, & Kuller, 1996; Maxwell, Kozak, Desjardins-Denault, & Parboosingh, 1997).

An interesting finding was the difference in mammography rates among disabled and nondisabled women according to presence of and/or type of health insurance. Disabled and nondisabled women lacking health insurance reported the lowest rates of

mammography utilization in the previous year. This is consistent with the literature that indicates mammography utilization is related to the presence of health insurance coverage for the individual (Cummings, Whetstone, Shende, & Weismiller, 2000; Hsia et al., 2000; Lane, Zapka, Breen, Messina, & Fotheringham, 2000). Women with public health insurance (i.e., Medicare, Medicaid, etc.) had higher rates than did those lacking health insurance. Although the proportion of those with public health insurance was associated with higher mammography rates, it still lagged behind the mammography rates for women with only private health insurance. The highest rate of mammography utilization among both disabled and nondisabled populations was found among women with private health insurance. This finding is consistent with Wilcox-Gök's (2000) study in which aged (i.e., $\geq$ 65 years) and disabled Medicare beneficiaries (i.e., $<$ 65 years) having additional forms of health insurance (e.g., supplemental private plan, Medicaid, etc) demonstrated higher utilization of health care than did those with only Medicare coverage.

Last, disabled women had lower rates of mammography utilization in the previous year across all insurance types as compared to nondisabled women. Different incentives arising from characteristics of the health plan or providers may influence women's use of mammography (Bernstein, Thompson, & Harlan, 1991; Gordon, Rundall, & Parker, 1998; Potosky, Breen, Graubard, & Parsons, 1998). In addition, public sources of insurance (e.g., Medicaid, Medicare, etc.) may have less coordination of benefits than private sources (Gold, Sparer, & Chu, 1998) thus leading to lower utilization among public sources of insurance (Potosky, Breen, Graubard, & Parsons, 1998). The

association between public health plans and less coordination is particularly troubling considering that approximately 40% of disabled women in this study were covered by public health insurance plans as reported in Table 13.

Among disabled and nondisabled women, women who smoked had lower rates of mammography utilization in the previous year. This finding is consistent with the literature (Qureshi, Thacker, Litaker, & Kippes, 2000; Rakowski, Clark, & Ehrich, 1999) and reflects the importance of health behaviors and health care utilization. Women who engage in healthy behaviors (e.g., not smoking) may be more likely to engage in other activities that promote health (e.g., mammography, Pap testing, etc.), as demonstrated by and Hofer and Katz (1996) and Maxwell and colleagues (1997).

Likewise, the very strong association between CBE in the previous year and mammography screening cited by Cummings, Whetstone, Shende, and Weismiller (2000) was also noted in this study for both disabled and nondisabled women. Particularly striking was the large proportion of disabled women who reported mammography in the previous year who also reported undergoing a CBE. Among disabled women, approximately one-half had a CBE in the previous year. However, among disabled women who had a CBE in the previous year, nearly three-fourths reported mammography (see Table 14).

As with smoking status, preventive care such as CBE may be related to the individual's attempt to engage in healthy behaviors. Since CBE is an integral part of the early detection for breast cancer, it is logical that CBE and mammography are associated. Because CBE is conducted by a health care provider (e.g., physician, nurse, radiologic

technologist) the strong association between CBE and mammography may also indicate the influence of the health care provider on a woman's health care utilization (Frazier, Jiles, & Mayberry, 1996; Johnson & Meischke, 1994; Lane, Caplan, & Grimson, 1996; Saver, Taylor, Treadwell, & Cole, 1997). Furthermore, providers who conduct CBE may also recommend/promote mammography for their patients.

Larger proportions of women reporting mammography in the previous year also reported a usual source of health care. However, the difference in mammography utilization rates was lower among disabled women as compared to nondisabled women. Nonetheless, this finding may reflect the importance of a health care provider or source of care on one's utilization of health care. Having a particular health care provider or source of care may facilitate improved or more consistent health care. A consistent provider/source of health care may be better able to monitor and influence health care behaviors and outcomes (Martin, Calle, Wingo, & Heath, 1996; Maxwell, Kozak, Desjardins-Denault, & Parboosingh, 1997).

Overall, women with a higher number of barriers to health care utilization exhibited lower rates of mammography. However, among the disabled population, the differential in the mammography rate was not as large as compared to the nondisabled cohort. Among the disabled cohort, the presence of a disability may itself serve as a barrier to mammography utilization. The finding of lower mammography utilization in the presence of larger numbers of barriers is consistent with Rosenbach and Huber's (1993) finding that disabled Medicare beneficiaries < 65 years experience more barriers to medical care as compared to other beneficiaries.

The importance of the outcomes of health care were revealed by the significant findings regarding rate of mammography use for women according to previous breast cancer and presence/level of comorbid condition(s). The subanalysis conducted on 831 women for whom data on breast cancer history were available indicated that mammography rates are higher among women with a positive history of breast cancer. This finding is consistent for both disabled and nondisabled women. However, among nondisabled women, the difference in proportions was much less than for the disabled group. The mammography rates among women with a previous breast cancer diagnosis were roughly equivalent among the disabled and nondisabled populations. A higher mammography rate among women with breast cancer is an a priori assumption. Women with breast cancer experience the first-hand effects of the disease and, therefore, may be more cognizant of the importance of continued screening (Allen, Sorenson, Stoddard, Colditz, & Peterson, 1998; Paskett et al., 1998; Thomas, Fox, Leake, & Roetzheim, 1996; Vernon, Vogel, Halabi, & Bondy, 1993). However, among women lacking a previous history of breast cancer, only approximately 44% of the disabled cohort reported mammography in the previous year as compared to 62% of nondisabled women. The higher rates of mammography utilization among women with a previous history of breast cancer is consistent with previous studies, because women with a perceived risk or susceptibility to breast cancer may be more likely to utilize mammography (Coughlin, 1998; Mahmoodian, 1997; Maxwell, Bastani, & Warda, 1998; Montaño, Thompson, Taylor, & Mahloch, 1997).

The presence and/or level of comorbid conditions had an unequal effect on the two study samples (i.e., disabled and nondisabled women). Among disabled women, mammography rates were roughly equivalent regardless of the level of comorbid conditions. However, among nondisabled women, the proportion of women reporting mammography in the previous year declined among those with the highest levels of comorbid conditions. This finding for the nondisabled cohort is consistent with the literature (Blustein & Weiss, 1998; Hsia et al., 2000). Women with high levels of comorbid conditions may face a variety of health problems. Thus, their use of preventive care may be secondary to other health/functioning concerns (Blustein & Weiss, 1998).

The consistently lower rates of mammography utilization among the disabled population, regardless of level of comorbid condition(s), may again reflect the different health care experience of disabled women discussed throughout this study. The disabled are already faced with conditions and/or limitations that influence care-seeking behavior. Consequently, their burden may limit their access or ability to obtain mammography.

Although lower mammography rates were found for disabled women based on the various environmental, population characteristics, health behaviors, and health outcome variables, caution is warranted in identifying the factors influencing mammography utilization among disabled and nondisabled women. It is essential to analyze the results taking all possible factors/influences into account. Thus, the results from the logistic regression analysis can provide valuable information regarding the simultaneous influence of a variety of factors and conditions.

In this study, traditional measures of disability (e.g., presence of ADL or IADL) were supplemented by other variables that measure limitations of cognitive function and work limitations. The inclusion of broader measures of disability in this study yielded results that differ from previous studies. After controlling for all disability variables, only the cognitive limitation variable remained significant. Women with cognitive limitations were 34% less likely to have reported having mammography in the previous year as compared to other disability conditions. This finding is contrary to those reported by Ives, Lave, Traven, Schulz, & Kuller (1996) in which dementia did not influence mammography use after controlling for other limitations. In this study, functional limitations (i.e., ADL or IADL) did not influence mammography as demonstrated previously by Blustein and Weiss (1998); Chan et al. (1999); Iezzoni, McCarthy, Davis, and Siebens (2000); and Ives, Lave, Traven, Schulz, & Kuller (1996).

Among the aforementioned studies, the measurement and scaling of ADL and IADL limitations varied. For example, the measure of ADL limitations from the Medicare Current Beneficiary Survey used by Chan and colleagues (1999) and Blustein and Weiss (1998) consisted of self-reported difficulties in bathing/showering, dressing, walking, eating, toileting, and transferring from bed/chair. Unfortunately, Ives, Lave, Traven, Schulz, and Kuller (1996) did not explain how they operationalized their measures of ADL and IADL limitations (i.e., no explanation of what limitations comprised an ADL or IADL). Chan and colleagues used four levels for ADL (no limitation, 1-2 ADLs, 3-4 ADLs, and 5-6 ADLs) while Blustein and Weiss as well as Ives

and colleagues (1996) dichotomized ADL as no limitation or ≥ 1 ADL(s). In addition, Ives, Lave, Traven, Schulz, and Kuller (1996) also dichotomized IADL limitations.

The nonsignificant findings for ADL limitations in this study may differ from that of Chan and colleagues (1999) and Blustein and Weiss (1998) because the measure of ADL in this study did not include walking as a limitation. In addition, this study may differ from Chan and colleagues because ADL was dichotomized in this study (i.e., 0 versus ≥ 1 ADL) while Chan and colleagues examined four different levels to measure ADL limitations. Therefore, the dichotomous measure of ADL in this study may overestimated the influence of ADL on mammography utilization as compared to Chan and colleagues. However, this study may underestimate the influence of ADLs do to the exclusion of walking as an ADL limitation.

In comparing this study to others that investigated cognitive limitation/dementia, Ives and colleagues study used a more scientific evaluation of dementia (i.e., use of the Mini-Mental State Exam [MMSE]) than the broader self-reported measure of cognitive limitations used in this study (i.e., any self-reported limitations due to difficulty remembering or periods of confusion). Therefore, the comparison of cognitive limitations may not be equivalent. The finding that cognitive limitations significantly influence mammography utilization in this analysis while controlling for ADL, IADL, and work limitations may challenge these previous assumptions regarding the relationship between functional limitations and mammography utilization. Thus, consideration must be given to the significant impact of cognitive limitations on the preventive care behaviors of disabled women in future analyses.

Regarding the other factors that potentially influence mammography utilization, the regression analysis results indicated that only particular population characteristics and health behaviors were associated with mammography utilization in the previous year. After controlling for other factors, age exerted an independent influence on mammography screening. Older women (i.e., ≥ 80 years) were half as likely to report mammography in the previous year as compared to a younger age group (i.e., 50 –59 years). Lower utilization among older women has been demonstrated in the literature (Balducci & Phillips, 1998; Breen, Feuer, Depuy, & Zapka, 1997; Fox, Roetzheim, & Kingston, 1997; Halabi, Vogel, Bondy, & Vernon, 1993; Marwill, Freund, & Barry, 1996; Persky & Burack, 1997). Because debate exists regarding the efficacy and importance of mammography screening among women with advanced age, older women may not receive advice promoting mammography use from health care providers (Blustein & Weiss, 1998; Marwill, Freund, & Barry, 1996). Thus, continued evaluation of the efficacy of mammography among older women is warranted.

Race/ethnicity exerted a small yet significant influence on mammography utilization although findings differed partially from previous research. For example, the works of Bowen, Hickman, and Powers (1997); Hedegaard, Davidson, and Wright (1996); Hoffman-Goetz and Mills (1997); and Suarez, Roche, Nichols, and Simpson (1997) demonstrate that racial/ethnic minorities report lower mammography use than do Caucasian women. Similarly, in this study African-American women and women classified as 'other race/ethnicity' were less likely to undergo mammography in the previous year as compared to Caucasian women, after controlling for other factors.

However, Hispanic women were more likely to undergo mammography than the Caucasian group after controlling for other factors as reported previously in Table 15. This is a surprising finding considering that a previous study demonstrated that Hispanic women underutilize mammography (Suarez, Roche, Nichols, & Simpson, 1997). The results may reflect the positive effect of targeted programs to educate Hispanic women regarding the benefits of mammography screening (Scammon, Smith, & Beard, 1995; Skaer, Robison, Sclar, & Harding, 1996).

Level of education exerted a strong influence on mammography utilization. High school graduates were 37% more likely to report mammography in the previous year, after controlling for other factors. These results are consistent with other studies reporting higher mammography utilization among women with higher levels of education (Horton, Cruess, & Romans, 1996; Ives, Lave, Traven, Schulz, & Kuller, 1996; Mickey, Vezina, Worden, & Warner, 1997). Women with higher levels of education may be more aware of the benefits of health care and preventive screening and understand how to use health care services.

A final population characteristic that influenced mammography use in the logistic regression analysis is the presence/type of health insurance. The presence of any source of insurance increased the likelihood of a woman reporting mammography in the previous year. However, particular types of insurance were more likely to be associated with mammography utilization. For example, women with private forms of health insurance were 74% more likely to report mammography in the previous year as compared to women with no reported insurance. Likewise, women with health insurance

from public entities (i.e., Medicare, Medicaid, IHS, etc.) were also more likely to report mammography than women without health insurance.

However, the effect among women with public forms of health insurance was not as large as that for women with private health insurance. This is particularly important among the disabled population in this study as 40% of disabled women had public sources of health insurance (as compared to approximately 15% of nondisabled women). In this study, the proportion of disabled women ≥ 50 years old with public health insurance is similar to Wilcox-Gök's (2000) study of young disabled Medicare enrollees (i.e., < 65 years) in which only 37% reported only Medicare as health insurance coverage. Possibly, women with no health insurance or public forms of insurance may not receive adequate counseling for preventive health or may lack the coordination of care common with private health insurance (Gordon, Rundall, & Parker, 1998; Potosky, Breen, Graubard, & Parsons, 1998).

Overall, health behavior was also strongly associated with mammography utilization in the previous year based on the regression results. The most striking finding was the extremely strong and independent association between clinical breast examination (CBE) in the previous year and mammography utilization. After controlling for other variables, women who underwent a CBE were 34 times more likely to report a mammogram in the previous year. This finding is much larger than that reported in Cummings and colleagues' (2000) study of 843 rural women in which women reporting a CBE were 10 times more likely to have undergone a mammogram (AOR = 10.22; 95% CI: 6.04, 17.28). A potential explanation is that preventive care of the breast in the form

of CBE may carry over into additional forms of care such as mammography. In addition, women who visit facilities and/or providers that conduct CBEs may be more likely to be encouraged and/or scheduled for a mammogram.

Smoking is a behavior associated negatively with mammography. Women who smoke were less likely to report mammography in the previous year than are non-smokers. This finding is similar to that reported by Maxwell, Kozak, Desjardins-Denault, and Parboosingh (1997) and Hofer and Katz (1996). The association between preventive health behaviors/utilization and mammography supports the supposition that women who attempt to maximize their health are more likely to undergo mammography.

Women with a usual source of health care were nearly two times more likely to utilize mammography in the previous year. This finding may reflect the importance of physician recommendation on mammography utilization as reported by various authors (Frazier, Jiles, & Mayberry, 1996; Johnson & Meischke, 1994; Kelaher & Stellman, 2000; Lane, Caplan, & Grimson, 1996; Saver, Taylor, Treadwell, & Cole, 1997). Women reporting a usual health care facility and/or provider may receive continuity of care not encountered by those lacking a usual source of care. A source of care may also indicate a patient-provider relationship that promotes preventive care use such as mammography.

Analysis of women for whom breast cancer data were available (n = 830) indicated that previous diagnosis of breast cancer doubled the likelihood of mammography utilization, after controlling for other factors. This finding is consistent with the literature discussed previously that women with a history of breast cancer are

more likely to utilize mammography (Allen, Sorenson, Stoddard, Colditz, & Peterson, 1998; Paskett et al., 1998; Thomas, Fox, Leake, & Roetzheim, 1996; Vernon, Vogel, Halabi, & Bondy, 1993).

Based on the results of the logistic regression analysis, the four constructs of the health services utilization framework may not be applicable when examining mammography utilization among disabled and nondisabled women. Given results discussed in this section, a revised health services utilization framework for assessing the influence of various factors such as population characteristics and health behaviors on mammography utilization is shown in Figure 6.

Study results indicate that only particular population characteristics and health behaviors were associated with mammography utilization among women ≥ 50 years. Population characteristics such as the presence and/or type of health insurance coverage and education (i.e., a high school education or greater) were positively associated with mammography utilization in the previous year. However, cognitive limitation, age, and race/ethnicity were negatively associated with mammography utilization.

Among the variables measuring health behaviors, smoking status was found to be negatively associated with mammography utilization in the previous year. Health behaviors that were positively associated with mammography utilization include a clinical breast examination in the previous year as well as a usual source of health care. Particular variables measuring population characteristics (e.g., presence of a significant other and income) as well as variables measuring the environmental and health outcomes constructs were not significant in a controlled analysis.

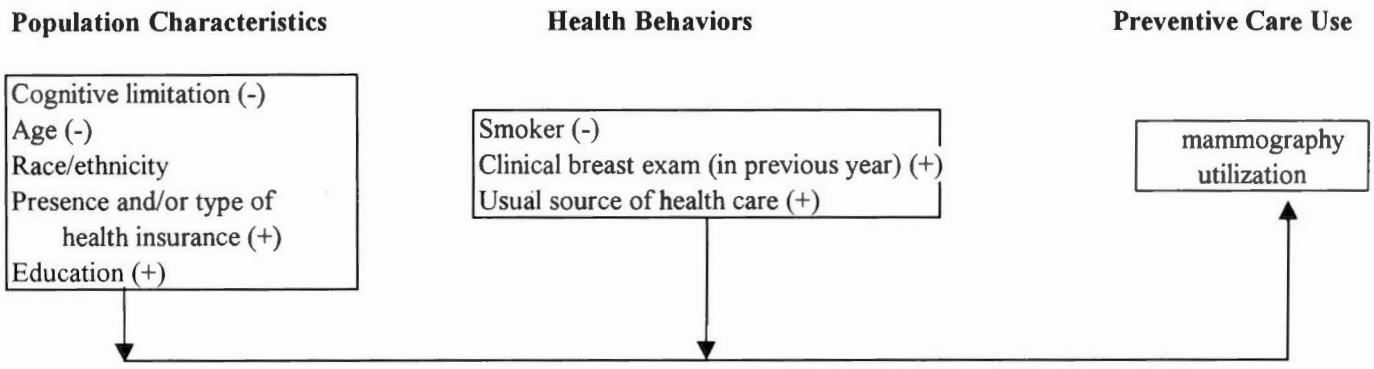

Figure 6.

Revised conceptual framework indicating the influences upon mammography utilization based upon logistic regression results.

Nonsignificant Influences/Effects

Some factors or characteristics that appeared to influence mammography utilization in other studies were not significant in this one. Although disabled women had significantly lower rates of mammography utilization in the previous year as compared to nondisabled women in each geographic region, the results did not demonstrate an independent effect of geographic region. Furthermore, the environmental factor of MSA residency was not significant. Because the MSA variable served as a proxy for rural residency, this study does not support a conclusion from a previous study that rural residency influences mammography utilization (Horton, Cruess, & Romans, 1996). Since mammography can be conducted in an outpatient facility, women residing in rural localities may have access to imaging centers. Furthermore, the lack of significance for the MSA variable may also reflect the success of outreach programs targeting rural women, including mammography vouchers (Stoner et al., 1998). Alternatively, the lack of significance may reflect the lack of specificity of the proxy variable used to designate rural residency.

Other factors that were associated with differences in mammography rates were not statistically significant after the regression analysis. Various variables, such as income and the presence of a significant other, were not influential variables after considering other factors. The finding regarding the lack of significance of income is interesting considering that previous research has demonstrated that lower income women often underutilize mammography (Breen & Kessler, 1994; Calle, Flanders, Thun, & Martin, 1993; Hsia et al., 2000; NCI Cancer Screening Consortium for Underserved

Women, 1995). However, the results of this study may differ from those of Calle, Flanders, Thun, and Martin as well as Hsia et al. due to different measures of income. Calle, Flanders, Thun, and Martin's income measure consisted of four levels comparing respondent's income to the federal poverty level (i.e., below poverty level, poverty level to 200% of poverty level, 200% to 300% of poverty level, and > 300% of poverty level). Hsia et al. measured household income using three levels (i.e., < $20,000; $20,000-$50,000; and > $50,000).

Another health behavior variable that was not significant was the level of reported barriers to health care use. This finding may reflect that women find ways of receiving mammography examinations despite barriers to health care use. Other factors may instill the necessity to undergo the exam, such as physician recommendation (Frazier, Jiles, & Mayberry, 1996; Johnson & Meischke, 1994; Lane, Caplan, & Grimson, 1996; Saver, Taylor, Treadwell, & Cole, 1997;) and previous health care behaviors (Hofer & Katz, 1996; Maxwell, Kozak, Desjardins-Denault, & Parboosingh, 1997).

The volume of health care was not a significant variable after controlling for other factors. Although a logical explanation is the association of increased volumes of health care with more opportunity to interact with their health care provider, it is possible that the quantity of interactions was not a critical factor in mammography utilization. Rather, the specific characteristics of the health care visit may have been more important with the emphasis upon quality not quantity of visits (Nutting et al., 2001).

It was assumed that mammography utilization would be related to obesity status among disabled and nondisabled women. As demonstrated previously by Wee,

McCarthy, Davis, and Phillips (2000), mammography utilization was significantly lower among obese women as compared to nonobese women. However, in this study mammography rates among disabled and nondisabled women did not vary according to obesity status after controlling for other factors. Contrary to the findings of Hsia et al. (2000) and Blustein and Weiss (1998), the level of comorbid conditions--a measure of the health outcomes construct derived from the health services utilization model--was not significant after controlling for other factors. Therefore, the presence of other disease or conditions did not adversely influence a woman's mammography behavior. Among disabled women, the presence of comorbid conditions may not deter mammography as much since this test is among other medical examinations that may be needed for the comorbidities.

Unmeasured Influences (limitations)

Data sources and methodology often limit studies of mammography utilization. This study, which examined the factors that influence mammography utilization in the previous year for disabled and nondisabled women ≥ 50 years, has many of the same limitations. Results indicate that many unmeasured factors that were unavailable in the dataset used influence mammography utilization among the study population, since only 44% of the variation was accounted for by the results.

Although preventive care utilization data from the 1998 National Health Interview Survey (NHIS) were supplemented with other NHIS files, additional potential influences could not be examined. For example, this study did not specifically measure a physician's recommendation for mammography. This unmeasured influence is important

as physician recommendation has been a consistent influence on a woman's decision to use mammography. Although the significant odds ratios evaluating just the influence of CBE and usual source of care may reflect the influence of a physician, the direct affect of physician recommendation on mammography utilization remains unknown. In addition, this study did not evaluate the influence of external influences upon an individual's mammography utilization such as media advertisements or educational programs.

Also not evaluated were physician characteristics as they were not in the database. As discussed in the literature review, characteristics of a woman's primary physician (e.g., gender, age, race/nationality, and medical specialty) may influence mammography utilization (Ackermann & Cheal, 1994; Andersen & Urban, 1997; Nutting et al., 2001; Roetzheim, Fox, & Leake, 1995; Saver, Taylor, Treadwell, & Cole, 1997). Unfortunately, this study could not evaluate if such physician characteristics influenced mammography utilization among the sample.

Relatedly, this study did not evaluate a woman's knowledge of breast cancer and mammography nor does the study assess women's fears or concerns regarding mammographic examinations. Women having erroneous knowledge and concerns may be less likely to undergo mammography. Although comorbid conditions and disability status were assessed, health status was not evaluated. Health status may influence care-seeking behavior. For example, women may have no functional, cognitive, or work limitations yet still have low self-reported health status. Furthermore, this study could not evaluate if a family history of breast cancer influenced mammography utilization due to lack of relevant personal data.

Limitations related to the data also included the creation of proxy variables. The variable measuring the presence of self-reported cognitive limitations (COGNITIV) may not accurately measure these limitations. In the NHIS, patients were asked if they had any limitations due to memory loss or confusion. It is possible that respondents with such limitations may not have been able to answer accurately the question. Furthermore, the NHIS question was vague and lacked the explicit categorization of conditions and symptoms common in other variables measuring limitations (e.g., ADLs and IADLs). Thus, further analysis of the influence of cognitive limitations and mammography utilization is needed.

Proxy variables were used to measure factors such as the environment (i.e., region of residency in U.S. and MSA size), population characteristics (i.e., income, significant other, presence/type of health insurance), health behaviors (volume of health care used, barriers to health care use), and health outcomes (comorbid conditions). As with any study, the creation of proxy variables and their designated levels of measurement may limit the results. For example, dichotomous variables such as income, MSA size, and volume of health care use may have lacked specificity regarding the measurement of their respective factors.

Another methodological concern that might have limited the results of this study includes the use of self-reported data. It is possible that response biases existed (Polit & Hungler, 1999) if respondents did not accurately answer the NHIS survey questions. However, this concern is minimal considering validation and reliability checks built into the NHIS. A final limitation was the cross-sectional nature of this study. The dependent

variable, mammography utilization, only measured self-reported mammography use in the previous year. Lacking are data to analyze women's long-term utilization of mammography. Analysis of mammography utilization trends may provide improved information for determining influential factors for mammography utilization over time.

Implications

Despite the limitations, this study makes an important contribution to the study of the factors influencing mammography utilization among disabled and nondisabled women. Conclusions and implications for practice, health care policy, and future research are discussed.

Practice

The importance of the health care provider-patient relationship must be underscored. This study demonstrated that cognitively disabled women are less likely to report the utilization of mammography in the previous year, after controlling for other factors. Based on the findings of Marwill, Freund, and Barry (1996), it is conceivable that women with cognitive limitations do not receive mammography recommendations from their physician. Therefore, health care providers (e.g., physicians, nurses, and other allied health professionals) and administrators (e.g., case workers, public health program director, etc.) should be targeted to be made aware of the factors that unknowingly influence their decision to recommend mammography, especially those caring for older cognitively impaired women.

Health care providers who care for disabled patients should also closely monitor the overall health care utilization of their patient. Rehabilitation specialists and

geriatricians, for example, may have continued contact with disabled women. Consequently, these providers have the potential to provide encouragement and information regarding measures for the early diagnosis of breast cancer although this may not be specifically in their specific medical purview. Furthermore, investigation into the interaction between health care providers and disabled women is needed to ensure that practice style and other factors related to health care providers encourages the recommendation for disabled women to undergo mammography.

The results of this study also indicate a need to identify women who may experience confusion and memory lapses that impair functioning. For example, health care providers and other health support personnel must attend more closely to indicators of cognitive limitations such as missed appointments and difficulty following medical advice/instructions. Furthermore, reminder and notification systems should be established that aid the cognitively impaired person (or a significant other or caregiver) in attending their mammography appointment. The health services literature demonstrates moderate success with clinical reminder systems (Kinsinger, Harris, Qaqish, Strecher, & Kaluzny, 1998; Kohatsu, Cramer, & Bohnstedt, 1994; Mandelblatt & Kanetsky, 1995). Incorporation of such methods as well as the extension to include spouses/significant others or members of the woman's social network may aid at improving mammography utilization.

A woman's health behaviors were strongly associated with the utilization of mammography in this study. Consistently, women with positive health behaviors (e.g., CBE in the previous year, non-smoker, having a usual source of health care, etc.)

reported higher rates of mammography utilization. Thus, it appears that a woman's preventive health activities and actions were associated with mammography use. From a clinical practice perspective, health care providers may use this information to selectively target preventive care messages. Women who do not engage in positive health behaviors are more likely targets of increased health promotion.

Related is the strong positive association between CBE and mammography utilization. Apparently, health activities related to breast cancer early detection (e.g., CBE) were strongly associated with continued care seeking behavior. Consequently, physicians and other health care providers must gain experience in and/or continue to perform CBE on their age-appropriate patients.

Last, women with a prior history of breast cancer were more likely to report mammography in the previous year. This finding supports previous studies in which women with a family or personal history of cancer, especially breast cancer, are more likely to undergo cancer detection (Allen, Sorenson, Stoddard, Colditz, & Peterson, 1998; Paskett et al., 1998; Thomas, Fox, Leake, & Roetzheim, 1996; Vernon, Vogel, Halabi, & Bondy, 1993). Women with a prior history of breast cancer may be more aware of the disease and undergo regular mammograms. However, caution is warranted regarding the influence of prior history of breast cancer on mammography utilization since this study result is based on a sample of only 830 women. Nonetheless, the benefits of mammography screening for all women should continue to be promoted to the patient by health care providers. Mammography is recommended regardless of perceived risk or susceptibility or whether symptoms exist.

Health and Social Policy

From a health policy perspective, this study undertook to determine if equity in mammography utilization existed among a nationally representative sample of U.S. women ≥ 50 years. Results from various analyses indicate that mammography rates among disabled women are significantly lower than among nondisabled women. Logistic regression results indicated that the presence of functional limitations (i.e., presence of ADL and IADLs) as well as work limitations were not significant influences upon mammography utilization in this analysis. Based on the results of this study, mammography does not appear to be utilized in an equitable manner among disabled and nondisabled women.

Among the various disability measures examined in this study, only cognitive limitations were associated statistically with mammography utilization. If the measure of cognitive limitation is valid, this finding supports the development of additional programs or interventions to meet the needs of a different disabled population than was assumed previously. For example, programs that specifically target functionally disabled women could be expanded to also provide support for women with limitations arising from memory problems and/or confusion. Despite the finding that cognitive limitations are significantly associated with mammography utilization, additional research into the role and evaluation of cognitive limitations is recommended. Additional research will be discussed in the ensuing section entitled Research.

From a health policy perspective, the role of health insurance is an important element to improve mammography utilization among disabled women. Disabled women

are more likely to rely on public sources (i.e., Medicaid, Medicare, etc.) or combinations of public and private sources of health care coverage (Wilcox-Gök, 2000). Although these sources of insurance do provide health insurance coverage, the disparity in utilization among the types of insurance is a concern. A significantly smaller proportion of women with public and public/private types of health insurance reported regular or recommended mammography use than did women with private health insurance. The disparity was largest among the disabled cohort.

Attention should focus on the cause(s) for lower mammography utilization among women with public sources of care, especially among disabled women. Is a central coordination of care lacking among public sources of health insurance? Should a program that tracks the mammography utilization of disabled women with Medicare and/or Medicaid be considered? Do physicians who treat women with public sources of health insurance fail to recommend mammography? Moreover, do characteristics of the public health care organization impair the utilization of mammography? Answers to these questions may allow for better coordination and/or planning of interventions to improve mammography utilization among women with public sources of health insurance. Programs to improve mammography utilization among disabled women that target patients, physicians, and other health care providers should be investigated. Furthermore, incentive programs may be required to promote mammography utilization among disabled women by health care providers who provide primary care.

Results indicated that lower proportions of disabled women had private insurance, and mammography utilization was higher in women with private health insurance. Thus,

a second policy concern relates to access to private health insurance by the disabled. Do socioeconomic factors prevent disabled women from acquiring private health insurance? Perhaps vouchers that permit the disabled to purchase private health insurance might be a policy option for future study.

A cost benefit or cost effectiveness analysis is needed to ensure that mandating use for a subpopulation is advantageous for society. The lower utilization rate among disabled and older women underscores the need for improved mammography recommendations for various subpopulations. Consistent with the recommendation of Marwill and colleagues (1996), practice guidelines for older women are needed that specify particular patient factors (i.e., age, cognitive limitation, etc.) as triggers for the recommendation of mammography. Unfortunately, current guidelines vary according to various national groups, and debate continues to exist regarding the efficacy of screening for older women (generally women > 75 years). An established and accepted guideline, based on scientific results, across all national, professional groups for mammography screening among older women may aid in improving recommendation for mammography among health care providers who do not know or accept current guidelines.

Research

The results of this study reflected a departure from previous research demonstrating an association between functional limitations and mammography utilization. This study demonstrated that cognitive limitations influence mammography utilization. Consequently, the investigation of the influence of disability upon preventive care utilization should include additional measures of disability/limitations

than those used previously. Specifically, further investigation of cognitive limitations and their influence on health care use is needed. This could be accomplished by better measurement of a cognitive limitation variable as well as measurement of other variables specific to the individual (e.g., a formal evaluation by a health care professional) to evaluate fully the influence of cognitive impairment and mammography.

Despite the advantages of the study, future research is necessary to evaluate factors and influences that could not be addressed. For example, a limitation in this study was the lack of data regarding physician recommendation for mammography. Previous research alludes to a decreased emphasis upon preventive care for disabled women by physicians (Marwill, Freund, & Barry, 1996). Data that are more specific are needed to determine if physicians promote mammography to disabled women at levels similar to nondisabled women. Future research should focus on the factors that may influence providers' behavior in commending mammography and on the interaction between physicians and all other health care providers with their disabled clientele.

For example, a review of medical records could be conducted to determine actual recommendation of mammography rates for disabled patients. Last, physicians, nurse practitioners, and other case workers who monitor care for the disabled could be surveyed to determine the proportion recommending mammography to disabled patients. Likewise, disabled women who have received recommendation to undergo mammography could be compared to a nondisabled cohort.

Future research should also focus on trends in mammography utilization. This study was limited in analyzing mammography use based on one year of data. Therefore, it is possible that disabled women's long-term use of mammography differs from the results demonstrated.

The Human Genome Project, headed by the National Human Genome Research Institute, offers the potential for unraveling the influence of DNA on various disease such as breast cancer. Research regarding a woman's genetic predisposition for breast cancer will aid in detection and treatment of the disease. However, the advent of human genomic research and genetic testing for breast cancer will result in new challenges with involving legal, ethical, and social implications (e.g., health insurance coverage, health policy, preventive health technology, etc).

Additional research should focus on a qualitative assessment of factors influencing mammography utilization among disabled and nondisabled women. A qualitative investigation of the practice style, beliefs, and attitudes of health care providers who care for disabled persons may provide a rich source of information upon which future interventions may be built. Furthermore, exploration of barriers to mammography use among disabled women would provide essential information for improving their utilization of health care.

Conclusions

Mammography is the most effective method for the early detection of breast cancer. Therefore, it is important to determine if mammography is utilized in an equitable manner by various populations in the U.S., such as the disabled. Inequitable

utilization occurs when the use of health care is based on factors other than need, such as income, presence of health insurance, health status, or the presence of disability/limitations.

In the effort to determine if inequity exists regarding their utilization of mammography, this study examined the factors that influence mammography utilization among a sample of disabled and nondisabled U.S. women ≥ 50 years. This project took a broad view of disability by assessing both physical and mental factors that are potential barriers to mammography use by the individual. This study improves understanding of mammography utilization among disabled women as it incorporates cognitive and work limitations in the definition of disability and uses a theoretical framework as a basis for the analysis. Furthermore, previous studies have used a restricted sample of women, generally women ≥ 65 years. The use of a nationally representative sample allowing for estimation based on approximately 30 million women is an additional strength of this analysis.

This study demonstrates that the proportion of disabled women who utilized mammography in the previous year was lower across a variety of dimensions (i.e., environmental, population characteristics, health behaviors, and health outcomes). Furthermore, in a simultaneous analysis of some of the countless factors and characteristics that influence mammography use, factors such as the presence of cognitive limitations, population characteristics (e.g., age, race/ethnicity, education level, and health insurance type), and health behaviors (e.g., smoking status, CBE in

the previous year, and a usual source of health care) had a statistically significant influence upon mammography utilization in the previous year.

Previous research has demonstrated that the presence of functional limitations (i.e., ADL and IADLs) were associated with lower rates of mammography utilization among various populations (Blustein & Weiss, 1998; Chan et al., 1999; Iezzoni, McCarthy, Davis, & Siebens, 2000). Study results regarding functional disability and mammography utilization differed from previously published research.

In this study, functional limitations were not associated with mammography utilization as typically reported. Rather, cognitive limitations were significantly associated with mammography utilization after controlling for other factors. Because a different disability variable than those previous examined were significant in this controlled study, further research is recommended. Nonetheless, implications of the importance of cognitive disability on mammography utilization include the potential need to expand programs to improve mammography utilization among disabled women as well as the need to improve recommendation by physicians and providers for mammography utilization among disabled women.

Study results indicate that inequity in mammography utilization exists because disabled women's utilization rates are lower than are the rates for nondisabled women. Furthermore, mammography utilization may also be considered inequitable since factors such as disability status, income, and health insurance influence utilization. Because disabled women, especially those cognitively impaired, used mammography at lower rates than did nondisabled women, it is possible that disabled women may not

realize the benefits of early detection of breast cancer. Disabled women may have higher rates of undetected breast cancer and, therefore, potential for worse prognoses. Consequently, disabled women may experience higher mortality rates from breast cancer due to lack of mammography utilization.

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Appendix A

SUDAAN Coding

SUDAAN Coding

The data examined in this study is a subset of full NHIS data files. Subsetting refers to maintaining select records (e.g., women ≥ 50 years). However, caution is warranted when using subsetted data. Correct point estimates (e.g., the subdomain means) can be computed but standard errors may be computed incorrectly when using a compromised design structure (NCHS, 2000). To eliminate this problem, a fix-up recommended in the NHIS codebook (NCHS, 2000) was used. The MISSUNIT option on the NEST statement was included:

NEST STRATUM PSU/ MISSUNIT ;

MISSUNIT is used when using subsetted data. This code statement adjusts for missing PSU data by using the square of the Taylorized deviation of the PSU. For additional information see Shah, Barnwell, and Bieler (1997).

Appendix B

Summary of Statistical Testing

Summary of Statistical Testing

In Chapter 4: Results, various statistical tests were employed to evaluate differences in the proportions of disabled and nondisabled women based on various factors as well as the proportion of women utilizing mammography. The main statistical tests were testing of two proportions and chi-square analysis. Testing was conducted on national-level data.

The following is a listing and statistical results for test of proportions among the various groups/factors as discussed in Chapter 4. The results are reported according to the various subgroups:

Mammography utilization rates **among disabled women** based on:

- significant other (50.30%) v. no significant other (38.14) $z = 299.83$ $p = .00$
- Caucasian v. nonCaucasian groups (3) $X^2 = 4.98$ $p = .18$
- usual source of care (43.92%) v. no usual source (20.02%) $z = 284.74$ $p = .00$
- nonsmokers (43.55%) v. smokers (40.66%) $z = 58.05$ $p = .00$
- 1-2 reported barriers (36.45%) v. 3-5 barriers (42.78%) $z = 50.60$ $p = .00$
- < 10 visits (40.11%) v. ≥ 10 visits (46.22%) $z = 153.51$ $p = .00$
- obese (48.66%) v. nonobese (48.66%). $z = 187.89$ $p = .00$

Mammography utilization rates among **nondisabled women** based on:

- Caucasian v. nonCaucasian groups (3) $X^2 = 15.28$ $p < .01$
- nonsmokers (59.77%) v. smokers (45.02%) $z = 545.71$ $p = .00$
- usual source of care (59.64%) v. no usual source (21.53%) $z = 1076.65$ $p = .00$

- obese (58.42) v. nonobese (57.03%) $z = 59.93$ $p = .00$
- 3 - 4 comorbidities (41.57%) v. 0 comorbidities (55.57%) $z = 182.84$ $p = .00$
- + breast cancer (73.20%) v. no previous history (43.94%) $z = 329.77$ $p = .00$

Comparisons **between disabled and nondisabled** women based on:

- ≥ 60 years: disabled (70.95%) v. nondisabled (59.21%) $z = 565.80$ $p = .00$
- African-Americans: disabled (13.30%) v. nondisabled (8.21%) $z = 345.96$ $p = .00$
- annual income < $20,000: disabled (58.09%) v. nondisabled (26.47%) $z = 1456.33$ $p = .00$
- usual source of care: disabled (96.11%) v. nondisabled (94.05%) $z = 225.88$ $p = .00$
- CBE in previous year: disabled (54.34%) v. nondisabled (64.16%) $z = 442.33$ $p = .00$
- nonobese disabled (69.60%) v. nondisabled (75.84%) $z = 306.12$ $p = .00$
- 1-2 comorbidities: disabled (61.77%) v. nondisabled (41.68%) $z = 917.49$ $p = .00$
- 3 – 4 comorbidities: disabled (8.90%) v. nondisabled (1.73%) $z = 611.12$ $p = .00$
- + breast cancer: disabled (30.55%) v. nondisabled (35.09%) $z = 658.49$ $p = .00$

Comparison of mammography utilization rates **between disabled and nondisabled** women based on:

- disabled (42.99%) v. nondisabled (57.37%) $z = 646.83$ $p = .00$
- Northeast residency: disabled (46.06%) v. nondisabled (61.03%) $z = 291.38$ $p = .00$
- West residency: disabled (39.49%) v. nondisabled (57.17%) $z = 357.47$ $p = .00$

- MSA residency: disabled (44.11%) v. nondisabled (58.98%) $z = 570.65$ $p = .00$
- nonMSA residency: disabled (40.12%) v. nondisabled (51.74%) $z = 271.34$ $p = .00$
- high school graduate: disabled (48.25%) v. nondisabled (60.88%) $z = 435.96$ $p = .00$
- private health insurance: disabled (63.69%) v. nondisabled (64.31%) $z = 12.71$ $p = .00$
- cognitive limitations: yes (34.36%) v. no $z = 525.49$ $p = .00$
- annual income < $20,000: disabled (38.17%) v. nondisabled (45.28%) $z = 220.99$ $p = .00$
- annual income ≥ $20,000: disabled (49.67%) v. nondisabled (61.72%) $z = 364.58$ $p = .00$
- private insurance: disabled (41.10%) v. nondisabled (64.31%) $z = 12.71$ $p = .00$
- smokers: disabled (40.66%) v. nondisabled (45.02%) $z = 85.34$ $p = .00$
- previous CBE: disabled (73.15%) v. nondisabled (83.51%) $z = 400.31$ $p = .00$
- obese: disabled (48.66%) v. nondisabled (58.42%) $z = 234.36$ $p = .0$
- nonobese: disabled (40.51%) v. nondisabled (57.03%) $z = 187.89$ $p = .00$
- 0 comorbidities: disabled (42.64%) v. nondisabled (55.57%) $z = 331.55$ $p = .00$
- 1-2 comorbidities: disabled (43.40%) v. nondisabled (60.39%) $z = 580.63$ $p = .00$
- 3-4 comorbidities: disabled (41.96%) v. nondisabled (41.57%) $z = 3.86$ $p = .00$

Miscellaneous-mammography utilization comparison:

- cognitive limitation (34.36%) v. noncognitive limitation (55.49%) $z = 525.49$ $p = .00$

Appendix C

Correlation Matrix For Independent Variables

CORRELATION MATRIX FOR INDEPENDENT VARIABLES

	ADL	IADL	COGNITIV	WORKLIM	REGION	NONMSA	AGE	RACECAT	HSGRAD	INCOME	SIGOTHER
ADL	1.00										
IADL	.477	1.00									
COGNITIV	.246	.291	1.00								
WORKLIM	.301	.467	.271	1.00							
REGION	.018	.027	.036	.025	1.00						
NONMSA	.023	.038	.004	.063	.021	1.00					
AGE	.133	.237	.097	.075	-.020	.024	1.00				
RACECAT	.020	.015	.010	.033	-.033	-.002	-.034	1.00			
HSGRAD	-.090	-.138	-.116	-.184	-.029	-.078	.202	.052	1.00		
INCOME	-.121	-.211	-.144	-.265	-.021	-.094	-.324	-.007	.371	1.00	
SIGOTHER	-.069	-.147	-.096	-.128	.014	.036	-.297	-.080	.145	.406	1.00
INSURANC	.064	.158	.055	.102	-.077	.028	.672	-.009	-.088	-.199	-.191
SMOKER	.004	-.014	.019	.061	.014	.002	-.199	.011	-.032	-.031	-.037
CBE	-.059	-.070	-.063	-.048	-.065	-.074	-.110	.009	.141	.179	.105
USUALCR	.029	.044	.018	.032	-.045	-.016	.106	.001	.026	.057	.024
BARRIER	.085	.112	.108	.164	.064	.013	-.103	.028	-.070	-.163	-.071
VOLUME	.230	.278	.186	.327	-.015	.026	.036	.010	-.081	-.134	-.072
OBESITY	.012	.017	.011	.075	-.014	.027	-.153	.038	-.048	-.051	-.010
BREASTCA	-.012	-.056	-.013	-.036	.008	-.066	.082	.063	.061	-.265	-.025
COMORBID	.142	.203	.123	.198	-.035	.019	.240	.055	-.154	-.176	-.109

CORRELATION MATRIX FOR INDEPENDENT VARIABLES

	INSURANC	SMOKER	CBE	USUALCR	BARRIER	VOLUME	OBESITY	BREASTCA	COMORBID
INSURANC	1.00								
SMOKER	-.153	1.00							
CBE	-.006	.059	1.00						
USUALCR	.186	-.078	.192	1.00					
BARRIER	-.163	.106	-.082	-.135	1.00				
VOLUME	.081	.011	.048	.086	.124	1.00			
OBESITY	-.103	-.066	.017	.005	.068	.087	1.00		
BREASTCA	.068	-.082	.136	.079	-.071	.030	-.007	1.00	
COMORBID	.217	-.071	.014	.123	.057	.194	.157	-.010	1.00

Appendix D

Characteristics of the Cognitive and Noncognitive Disabled Populations

Characteristics of the Cognitive and Noncognitive Disability Populations

Characteristic	Weighted Sample Prevalence (%) Cognitive Disability (sample n = 321)	No cognitive Disability (sample n = 5,732)	X^{2a}
Mammography utilization	44.51	55.49	
Disability[b]			
Activities of daily living	22.29	2.30	44.23***
Instrumental activities of daily living	48.61	8.05	87.79***
Work	53.12	12.74	27.09***
Environmental factors			
Region			13.44**
Northeast	25.60	21.37	
Midwest	21.26	25.60	
South	38.92	34.89	
West	25.60	18.14	
MSA-designated locale			
Yes	23.37	76.63	0.37
No	25.31	74.69	
Population characteristics			
Age (years)			28.06***
50-59	28.93	38.91	
60-69	16.74	27.34	
70-79	22.38	22.94	
≥ 80	31.95	10.81	

Characteristic	Weighted Sample Prevalence (%) Cognitive Disability (sample n = 321)	No cognitive Disability (sample n = 5,732)	X^{2a}
Race/ethnicity			14.15**
Hispanic	9.70	5.86	
Caucasian	73.03	82.48	
African-American	7.60	8.96	
Other	2.54	2.70	
Educational level			44.71***
High school graduate	51.20	75.59	
< high school	48.80	24.41	
Income (annual household)			52.40***
≥ $20,000	42.00	68.45	
< $20,000	58.00	31.55	
Significant other			44.98***
Yes	33.47	57.27	
No	66.53	42.73	
Health insurance			74.71***
No insurance	7.00	6.04	
Private only	14.07	42.87	
Public only	45.27	18.79	
Private and public	33.66	32.30	
Health behaviors			
Smoking status			2.20
Yes	20.91	16.75	
No	79.09	83.25	
Clinical breast exam (previous year)			14.65**
Yes	48.54	62.87	
No	51.46	37.13	

Appendix D (continued)

Characteristic	Weighted Sample Prevalence (%) Cognitive Disability (sample n = 321)	No Cognitive Disability (sample n = 5,732)	X^{2a}
Usual source of care			1.93
Yes	96.17	94.38	
No	3.83	5.62	
Barriers to health care use			23.63***
0	72.83	87.08	
1-2	22.64	12.07	
3-5	4.52	0.85	
Volume of health care use			64.18***
<10 visits	48.45	82.01	
≥10 visits	51.55	17.99	
Health outcomes			
Obese			0.00
Yes	25.33	25.42	
No	74.67	74.58	
Previous breast cancer[c]			
Yes	29.38	34.01	0.30
No	70.62	65.99	
Comorbid conditions			45.96***
0	27.82	52.29	
1-2	62.44	44.87	
3-4	9.74	2.84	

[a]Chi square analysis conducted on groups within categorical variables.

[b]Limitations are not mutually exclusive.

[c]Results based on 830 total responses.

*$p < .05$. **$p < .01$. ***$p < .0001$.

Vita